The Journal of Parasitology

Volume XX DECEMBER, 1933 Number 2

N. A. COBB: NEW NEMIC GENERA AND SPECIES, WITH TAXONOMIC NOTES

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In connection with the completion of the work on Dr. Cobb's key to the genera of free-living nemas, we find it necessary to publish from his manuscript material the new genera here presented, and to report some of the usages we have adopted in the matter of nomenclature.

The subfamily Richtersiinae (emend for Richtersiaceae) Kreis 1929, type genus *Richtersia*, Steiner 1916, is accepted.

The genera *Ceramonema* Cobb 1920, *Pselionema* Cobb 1933, (see table below) and *Pristionema* (described below) are grouped in the new subfamily Ceramoneminae. Type genus, *Ceramonema* Cobb 1920. These two subfamilies stand at present in the family Desmodoridae Steiner 1927.

The subfamily Selachineminae, Cobb 1915, must be placed not in the Enoplidae but beside the cyatholaims, which with their relatives probably constitute a group of at least family rank. At present the Cyatholaiminae and thus the Selachineminae stand in the family Chromadoridae. The Selachineminae do not bear the resemblance to *Enoploides* and its relatives which was originally suggested; their multispiral amphids, ornamented cuticle, cuticular pores and chromadoroid male supplements are evidence for the present placement. The genera included are *Selachinema* Cobb 1915, and *Cheironchus* Cobb 1917 (= *Dignathonema* Fil. (1918) 1921), in which the dorsal mandible is vestigial, and the genus *Synonchium* Cobb 1920, with three mandibles, beside which must be placed *Synonchiella*, described below.

Among the new or little used generic names which we found it necessary to adopt in the course of the work are those in the following table:

Genus	Former Name	Reason for change
Brachynemella Cobb. nom. nov.	*Brachynema* Cobb 1893	Preëmpt
Calyptronema Marion 1870	*Catalaimus* Cobb 1920	Synonym
Dasynemella Cobb nom. nov.	*Dasynema* Cobb 1920	Preëmpt
Drepanonema Cobb nom. nov.	*Chaetosoma* Clap. 1863	Preëmpt

* The coöperation of the Division of Nematology, Bureau of Plant Industry, in the preparation of this material has been invaluable.

Genus	Former Name	Reason for change
Odontocricus Steiner 1914	*Euchromadora* (*Odontocricus*) Steiner 1914	Raised to generic rank
Ogma Southern 1914	*Iota* Cobb 1913	Preëmpt
Pselionema Cobb nom. nov.	*Steineria* Fil. (1922) 1925	Preëmpt
Spilophorium Cobb nom. nov.	*Spilophora* Bast. 1865	Preëmpt
Steineria Stekhoven & de Coninck 1932	*Monhystera* (*Steineria*) Micol. 1922	Raised to generic rank
Steineriella Allgen 1932	*Steineria* Ditlev. 1928	Preëmpt
Trileptium Cobb nom. nov.	*Trilepta* Cobb 1920	Preëmpt
Turbatrix Peters 1927	*Anguillula* auctores	Misapplied

Family ENOPLIDAE

1. *Antopus,* N. A. Cobb, n. g.

Generic diagnosis: Enoplidae (Leptosomatinae): Cuticle unstriated. Cephalic setae six, others none, except pre- and post-anal on male. Pharynx none, no distinct lips or papillae. Oesophagus widening gradually, without bulb. Amphid not seen. Two dorso-sublateral rows of "pits" on neck. Tail tapering rapidly from anus, then gradually; swollen posteriorly. Caudal glands behind anus, filling base of tail. Vulva anterior, ovaries two, both doubly reflexed, the posterior much the longer. Spicula apparently slender, gubernaculum a very small straight piece.

Type: A. serialis (Baylis, 1916) N. A. Cobb.

Synonym: Stenolaimus serialis Baylis, 1916.

Antopus serialis (Baylis, 1916), N. A. Cobb, n. comb.

Diagnosis: (See original description.)

$$\frac{0.2\ 7.\ 15.\ \text{'26'}.\ 92.3}{0.7\ ?\ 2.4\ 3.8\ 1.6}\ 5\text{–}6\text{ mm.}\qquad \frac{0.2\ 7.5\ 15.4\ M\ 94.}{0.6\ ?\ 2.8\ 4.1\ 1.6}\ 5\text{–}6\text{ mm.}$$

Habitat: Under stones, Roy Cove, Falkland Islands.

2. *Tubolaimella,* N. A. Cobb, n. g.

Diagnosis: Enoplidae (Leptosomatinae). Cuticle thin, striae very fine; wings none. Body wall unusually thick. Cuticular pores none. Labial papillae six, labial setae six; lip region small, contour of head irregular on account of method of attachment of setae. Cephalic setae ten, long; subcephalic four. Cervical setae present, somatic and caudal absent. Amphidial opening transverse, internal pocket present. Odontia probably present, minute, filling vestibule. Pharynx closed, fairly well cutinized, apparent as a dark streak in the head. Oesophagus without bulb; cardia flattish. Tail conoid then cylindroid; spinneret unarmed. Ovaries two, reflexed. Genus resembling *Barbonema* but differing in the presence of the pharynx and probably odontia. Similarly separated from *Thalassoalaimus,* and also by the large cephalic setae and smaller amphids.

Type: T. setosa.

Tubolaimella setosa, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.5\ 6.3\ 13.\ \text{'53'}.\ 96.9}{0.3\ 1.1\ 1.3\ 1.7\ 0.7}$ 5.6 mm. Body wall occupying half radius. Labial setae as long as lip region is wide. Longest cephalic setae three times as long as head is wide, strongly and plainly innervated, bases set off by a shallow encircling groove. Amphidial opening a slit one-fifth as long as head is wide. Pharynx one and one-half times as deep as head is wide. Tail cylindroid in posterior half, about half as wide as at anus. Spinneret convex-conoid, rather pointed. Ova at uteri four times as long as body is wide; one-sixth to one-eighth as wide as long. Ampulla and excretory pore probably just behind cephalic setae.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachusetts. It is possible that there is a fresh-water spring on the ocean floor in this "hole."

3. *Angustinema,* N. A. Cobb, n. g.

Diagnosis: Enoplidae (Oxystominae?). Cuticle with exceedingly fine striae; wings none. Cuticular pores none. Lips six, confluent; head not set off. Setae 0. Amphid obscure, probably long-oval. Pharynx more or less cylindroid, with refractive wall, narrow, unarmed. Oesophagus without bulb, seeming to flatten out over the end of the intestine. Tail conoid then cylindroid; spinneret present. Ovaries two; reflexed. Distinguished from other Oxystominae by the more conspicuous pharynx and the absence of all setae.

Type: A. nudum.

Angustinema nudum, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.3\ 9.5\ 16.\ \text{m}58'.^{9}\ 96.2}{0.3\ 0.8\ 0.8\ 1.0\ 0.7}$ 3.1 mm. Contour plain. Amphid probably about one-sixth as wide as head, and one and one-half head-widths from anterior extremity. Vestibule small, walls relatively massive; pharynx narrowing slightly, extending back one head-width. Excretory pore just behind nerve ring; ampulla one-third neck-width, duct one-fifth neck-width. Posterior one-third of tail two-fifths as wide as at anus; spinneret distinct, convex-conoid, and obliquely truncate at apex. Ovum at uterus tapering, about twice as long as body is wide, and about half as wide as body.

Habitat: Marine mud, nine and one-half fathoms, near Woods Hole, Massachusetts.

4. *Halalaimoides,* N. A. Cobb, n. g.

Diagnosis: Enoplidae (Oxystominae, Fil.). Cuticle thin, striae extremely fine, contour plain. Wings absent. Amphid narrow, longitudinal and very long. Head set off by contraction and "structureless" appearance. Cephalic setae apparently four, possibly labial setose papillae also. Pharynx if present minute, closed. Oesophagus very long, narrow, without bulb. Tail tapering to hair-fine terminus, without spinneret. Spicula two, equal, slender, nearly straight, cephalated by constriction. Gubernaculum not seen, but specimen apparently somewhat immature.

Halalaimoides resembles *Halalaimus, Tycondora* and *Nuada,* but differs from them as hitherto described in the extreme length of the tapering neck, 43% as compared with about 25%, and in the absence of a spinneret.

Type: H. acuminata.

Halalaimoides acuminata, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.3(?)\ 32.\ 43.\ M\ 89.}{0.3(?)\ 1.6\ 2.1\ 2.3\ 1.4}$ 0.9 mm. The head is less than one-sixth as wide as the middle of the body. Amphid not clearly seen, on anterior third of neck, and several times as long as neck is wide. Nerve ring surrounding oesophagus somewhat squarely. Spicula about one and one-half times as long as anal body diameter, and one-fifth as wide.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachusetts.

5. *Cyathonchus,* N. A. Cobb, n. g.

Diagnosis: Enoplidae (Trilobinae). Striae of the thin cuticle very fine, not altered laterally. External amphid several head-widths removed from anterior extremity, transverse-oval, with internal pocket. Lips six, transparent, mobile, seen from in front broadly triangular, with an acute edge or point, and supported at bases by twelve refractive zig-zag elements. Labial setae six; cephalic six, jointed; subcephalic four, far back. Pharynx with vestibule striated by folding of lips, then rounded-cyathiform with refractive elements reaching halfway to

anterior end. Dorsal onchium conoid, acute, well-developed but not filling the cavity. Oesophagus cylindroid but with a small posterior portion slightly set off by constrictions in front and behind. Rectum long. Tail setaceous in posterior half, spinneret absent. Ovaries two, reflexed. Resembles *Onchulus,* from which it is distinguished by the acute edges or points of the lips, lack of an open posterior portion in the pharynx, and the jointed cephalic setae. Excretory pore in the single species of *Onchulus* opposite the pharynx; in the single species presented here, near the nerve ring.

Type: C. tennuicaudatus.

Cyathonchus tenuicaudatus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.0\ 7.2\ 15.\ ^{9'}41'.^{12}\ 63.}{1.5\ 1.7\ 2.2\ 2.5\ 1.4}$ 1.9 mm. Amphid three times as far back as the base of pharynx, and one-fifth as wide as neck. Labial setae not much longer than bases of cephalic setae are wide; cephalic setae about one-half as long as head is wide, subcephalic (twice as far back as base of pharynx) almost as long as cephalic. Ventral contour of onchium almost axial, base about twice as wide as base of cephalic seta, altitude slightly greater. Rectum nearly twice as long as anal body diameter. Contour of tail distinctly crenate: caudal setae inconspicuous, scattered.

Habitat: Seaweed, Nobsca Pond (fresh to brackish), Woods Hole, Massachusetts.

Family MONHYSTERIDAE

6. *Cenolaimus,* N. A. Cobb, n. g.

Diagnosis: Monhysteridae (Monhysterinae). Striae deep, grooving the cuticle. Cephalic setae sixteen (two in each lateral and three in each submedial position), very long and slender. Pharynx spacious, base more or less truncate, walls nearly parallel, wider anteriorly, thinly surrounded by esophagus. Spinneret armed with two long setae. Either the spicula or (more likely) the thin, parallel accessory pieces bifurcated distally. Supplementary organs absent. Genus resembling Omicronema, but differing in the deeply striated cuticle, the shape of the pharynx, the number and length of the cephalic setae, the bifurcation of the tips of the spicula (or accessory pieces) and the presence of setae at the spinneret.

Type: C. supersentiens.

Cenolaimus supersentiens, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{2.2\ 7.\ 12.\ ^{66}M\ 88.7}{1.5\ 2.\ 2.3\ 2.3\ 1.9}$ 1.2 mm. Wings none. Annules ceasing gradually opposite circular amphids and posterior part of pharynx. Amphid nearly two-thirds as wide as cylindroid head. Cephalic setae about four times as long as head is wide; no other setae except on tail. Pharynx three-fourths as wide as head anteriorly, tapering slightly to truncate base. Cardia conoid, one-third as wide as neck. Scattered pigment granules in narrow longitudinal lines in the oesophagus. Posterior half of tail cylindroid, about one-sixth as wide as at anus. Setae at base of spinneret three to four times as long as its diameter. Spicula more or less L-shaped, about one and one-half times as long as anal body diameter, slightly wider than one annule, uniform, cephalated by expansion.

Habitat: Marine mud and sand, Noumea, New Caledonia.

7. *Pulchranemella,* N. A. Cobb, n. g.

Diagnosis: Monhysteridae (Monhysterinae?). Contour crenate, striae plain, portion definitely set off on lateral fields. Pores absent. Lips six, each with a setose papilla. Lip region with refractive elements, set off by slight contriction, in which are set ten large jointed cephalic setae, each with a fine projecting proc-

ess at the tip. Cervical setae slender, along submedian line. Wall of pharynx behind lip region thick, refractive, apparently with three thickened columns. Amphid circular, depressed. Cylindroid oesophagus beginning behind pharynx. Male tail long, conoid then cylindroid, with short spinneret. Testis one. Spicula thick-walled, cephalated by a broad constriction, brownish or yellowish; apophysate gubernaculum rather complex, surrounding distal part of spicula. No male supplements. Setae on tail ventro-submedial.

This genus seems to resemble *Eumorpholaimus* (Monhysterinae) Schulz, 1932, from which it may be distinguished by the structure of the pharynx, with its three supporting columns and its large vestibule, which is not separated by a cuticular ring as is that of *Eumorpholaimus*. It differs also in the presence of wings, and in the form of the spicula and gubernaculum.

Type: P. setosa.

Pulchranemella setosa, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.8\ 9.3\ 20.\ ^{68}\text{–M}\ 86.}{2.2\ 3.5\ 3.5\ 4.4\ 2.8}$ 1.4 mm. Differentiation on lateral fields about as wide as two annules of the cuticle, the striae passing across the set-off region. Lip region half as high as wide, cephalic setae slightly unequal in length, longer than head is wide. Setae on neck, body and tail very slender, half as long as corresponding body diameter. Amphid opposite base of pharynx, about two-fifths head width. Narrow portion of tail one-eighth as wide as base. Nerve ring surrounding the oesophagus somewhat squarely. Spicula nearly one and one-half times as long as anal body diameter, at widest about one-sixth as wide as body, rather sharply curved, heads colorless. Telamon pieces distinct. Apophysis colorless, cephalated at both ends.

Habitat: Beach sand, Woods Hole, Mass.

8. *Cryptolaimus,* N. A. Cobb, n. g.

Diagnosis: Monhysteridae (Linhomoeinae Fil.). Striae fine, resolvable under favorable conditions into rows of dots, sometimes interrupted on lateral fields by double linear wings. Amphid large, circular, deep, with central mound. Cephalic setae four, submedian; sometimes further back one dorsal and one ventral seta, and still further back a seta behind each amphid. Pharynx small, without cuticularized rings, convex-obconoid in outline, the "cavity" perhaps not hollow, its base formed by anterior outline of oesophagus. Neck less than five per cent. Cardiac bulb pyriform sometimes valvate. Ventriculus present. Ovaries paired, outstretched. Tail finely setaceous at terminus (at least until final moult when it may become short, rounded) making the presence or absence of spinneret difficult to determine—apparently sometimes present. Male not seen.

Genus showing considerable resemblance to *Metalinhomoeus* and *Terschellingia,* for instance in the unusually short oesophagus with broad bulb and the obvious centriculus, or modified anterior region of the intestine. Arrangement of setae on the head also like *Metalinhomoeus.* Head however more conoid, base of pharynx not cuticularized as in *Metalinhomoeus,* and the cardiac bulb not always valvate. Shape of pharynx differing from that of *Terschellingia.* In present specimens of *C. cylindricollis,* preserved during moulting, lips everted as a tripartite "knob."

Type: C. cylindricollis, n. sp.

Cryptolaimus cylindricollis, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.5\ 2.5\ :\ 4.6\ \text{–}50\text{–}\ 92.5}{0.9\ 1.3\ :\ 1.4\ \ 1.5\ \ 1.1}$ 2. mm. Wings absent, striae not modified on lateral fields. Amphid 1/3 as wide as head, removed from anterior end by more than 1/2 head width or more than its own diameter. Sub-median cephalic setae 4, as long as head is wide; one dorsal and one ventral seta further back, and one behind each amphid. Lips in moulting specimens

projected as a tripartite "knob." Cardiac bulb not valvate. Ventriculus one to two body widths long, differentiated by absence of brownish-yellow granules. Excretory pore a little in front of cardiac bulb. Ova elongate.

Habitat: Marine mud and sand, Noumea, New Caledonia.

Cryptolaimus pellucidus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.4 \div 3.2\ 4.7\ -50-\ 84.8}{0.8 \div 1.3\ \underline{1.5}\ 1.9\ \ 1.2}$ 2.6 mm. Wings double. Amphid about two-thirds as wide as head, removed from the anterior end by about one-half its own diameter. Submedian cephalic setae four, as long as head is wide. Cardiac bulb with simple valve. Nerve ring just in front of cardiac bulb. Tail tapering, posterior one-fourth cylindroid, one-twelfth as wide as base. Spinneret unarmed, caudal glands apparently in base of tail. Eggs elongate, two to three times as long as body is wide, about one-fourth as wide as long.

Habitat: Mud with bivalves, in four to five feet of water, near Dynamite Hulk, North Arm, Port Adelaide, South Australia.

9. *Linolaimus,* N. A. Cobb, n. g.

Diagnosis: Monhysteridae. Cuticle with very fine plain striae, without wings. Cephalic setae four, large, at base of pharynx, *i.e.,* about one head-width back. Halfway from setae to anterior end there is a change in the character of the cuticle, which sets off the anterior end. Amphid large, circular, about on level of setae. Pharynx somewhat tubular, with a minute point of differing refractiveness less than halfway back. Oesophagus with valvate cardiac bulb, the musculature divided into two sub-equal parts. Ovaries two, reflexed. Spicula with duplex gubernaculum. Male supplements absent.

Type: L. quadricoma.

Linolaimus quadricoma, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.7\ 5.\ 7.4\ ^{16}47^{'21}\ 92.6}{0.7\ 1.4\ \underline{1.5}\ \ 2.\ \ \ 1.4}$ 1.8 mm. $\frac{0.6\ 3.9\ 5.9\ M\ \ 91.8}{0.5\ 1.2\ 1.1\ \underline{1.4}\ \ 1.2}$ 2.2 mm. Cephalic setae as long as head is wide. Amphid one-half head-with. The width of the head is slightly greater at the setae than it is before or behind this region. Pharynx inconspicuous, walls slightly refractive, one-fifth as wide as head. Cardiac valve one-half as long and one-fourth as wide as bulb. Tail conoid, arcuate. Spicula a little longer than anal body diameter, gubernaculum almost parallel.

Habitat: Beach sand, below low tide mark, in several feet of water, Woods Hole, Massachusetts.

Family CHROMADORIDAE

10. *Neotonchus,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Cyatholaiminae). Cuticle rather thin, on front of head exceedingly thin; striae of dots which are farther apart and less regularly arranged on the lateral fields. Contour flattish crenate. Pores none. Labial setae six, cephalic setae four. Amphids multispire, on front curvature of head. Pharynx cyathiform, with a long, ribbed vestibule, the (12?) ribs each of a series of pieces. Onchium dorsal, front contour at right angles to axis, axial contour slightly concave, somewhat like *Achromadora.* Cardiac bulb broadly pyriform, confluent, obscurely valvate. Tail more or less conoid, with spinneret. Spicula yellowish, blunt; gubernaculum narrow, rather conspicuous. Supplements chromadoroid, flattish. Testes two. Differs from *Achromadora* in the rather more forward position of the amphids, in the type of cuticular alteration on the lateral fields, in the absence of any ventral tooth, and in the presence of chromadoroid male supplementary organs.

Type: N. punctatus.

Neotonchus punctatus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.7\ 7.7\ 15.\ ^{85}\text{–M–}\ 90.}{2.3\ 3.1\ 3.4\ \ 3.6\ \ 3.}$ 1. mm. Cephalic setae about one-half as long as the corresponding diameter of the lip region, labial one-third as long as cephalic. Amphid of three winds, about two-thirds as wide as head, posterior border in front of onchium. Pharynx about three-fourths as deep as head is wide, vestibule about one-fourth as wide as middle or head. The radial elements of the musculature more scattered and more refractive around the pharynx than behind it. Cardiac bulb three-fourths as wide as neck. Cardiac constriction deep. Excretory pore probably a little behind nerve ring. Spinneret rounded, about one-fifth as wide as base of tail. Spicula slightly arcuate, not cephalated, slightly wider at middle, as long as anal body diameter. Gubernaculum two-thirds as long and half as wide as spicula. Male supplements eight to nine, the posterior one opposite proximal ends of spicula, separated by distances about equal to their width, anterior ones slightly farther apart.

In the posterior third of the tail, the lateral dots of the striae suddenly become finer and quite close together. This marking is separated from the rest of the dots by a vacant space nearly as wide as the marking itself, and is rather readily observable.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachusetts.

11. *Dispira,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Cyatholaiminae?). Cuticle thick, striae of dots which are coarser and farther apart forward from near nerve ring, not altered on lateral fields; wings none. Amphid large, multispire. Cuticular pores none. Lip region set off by constriction. Lips six, each a slightly arcuate, conoid flap or valve, supported by longitudinal thickenings of the cuticle. Setae in three circlets of six each, the second of very short setae, the third the longest. No other setae. Pharynx cyathiform but somewhat irregular, changing gradually to oesophagus lining, as deep as head is wide. Oesophagus surrounding pharynx; without bulb or swelling. Tail conoid, then cylindroid, with spinneret. Spicula with strongly cuticularized duplex gubernaculum. Male supplements numerous, preanal, ventral, chromadoroid in character. Testes probably 2, outstretched, opposed. Genus somewhat resembling *Dactylaimus,* but with cuticular striae resolvable into dots, labial framework more elaborately developed, and amphids larger and of more winds; less like *Pomponema,* which has onchia, and still more elaborate mouth structures.

Type: D. punctata.

Dispira punctata N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.1\ 7.8\ 19.\ ^{48}\text{M}\ 87.}{1.8\ 2.0\ \ 2.2\ \ 2.4\ \ 1.8}$ 1.5 mm. Amphids of eight winds, three-fourths as wide as head, center one and one-half head-widths from anterior end. Lips each edged by two narrow arcuate thickenings, between which are two parallel pieces; latter joining the outer two as they approach the blunt tips of the lips. Longest setae, on middle of lips, as long as head is wide. Tail in posterior half one-fourth to one-fifth as wide as at anus. Caudal glands in anterior half of tail. Spicula one-seventh as wide and one and one-half times as long as anal body diameter, cephalated by constriction. Male supplements seventeen. Excretory pore just behind the somewhat oblique nerve ring.

Habitat: Sand below beach, Woods Hole, Massachusetts.

12. *Dispirella,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Cyatholaiminae?). Striae exceedingly fine. Labial papillae probably six. Cephalic setae twelve. Amphid large, spiral, of many winds. Cuticular pores none. Lips probably six, thick at base but flap-like distally, arched over the small almost spheroid pharynx, which seems almost as

if set on the front of the head. Inside the base of the lips where the pharynx begins to close in rapidly, an encircling row of exceedingly minute elements, marking a rather definite angle in the contour of the pharynx. Oesophagus cylindroid except for almost imperceptible swelling near pharynx. Male tail conoid then cylindroid; spinneret rounded, with two flexible setae at base. "Reticulated" structures in lateral chords which press intestine aside. Spicula two, equal, arcuate, very slender. Gubernaculum appearing to surround spicula. Male preanal ventral supplements none.

Type: D. truncata.

Dispirella truncata, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.\ 4.3\ 11.\ M^{69}\ 90.}{1.3\ 1.8\ 1.8\ 2.2\ 1.6}$ 2.4 mm. The longer cephalic setae twice as long as the shorter, one and one-fourth times head width. Amphid three-fourths as wide as head, and two-thirds head-width from anterior extremity. Tail of male cylindroid in posterior third. Spicula one and one-third times as long as anal body, one-twentieth as wide, cephalated by expansion. Gubernaculum very inconspicuous.

Habitat: Beach sand, Woods Hole, Massachusetts.

13. *Synonchiella,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Selachineminae, Cobb, 1915). Cuticle usually with striae which are resolvable into a pattern of fine dots and dashes. Wings absent. Oesophagus with strong, definitely set off muscular pharyngeal bulb only. Ovaries two, reflexed. Genus closely resembling *Synonchium,* except that the three mandibles each have an even number of prongs, *i.e.,* two main central prongs instead of one, and that the cuticular elements include rod-like markings instead of dots only. It differs also in that there is a small gubernaculum with apophysis. and that the chromadoroid supplements are numerous, eight to over twenty, whereas *Synonchium* has two.

Tpye: S. truncata.

Synonchiella truncata, N. A. Cobb, n. sp.

Diagnosis: With the characters of the genus, and as indicated in the key. $\frac{1.9\ 7.\ 12\ ^{11}49'.^{14}\ 90.5}{2.7\ 3.\ 3.\ 3.8\ 2.6}$ 1.6 mm. $\frac{1.3\ 5.\ 13.\ M\ 91.8}{2.4\ 2.5\ 2.5\ 2.9\ 2.4}$ 1.6 mm.

Habitat: In sand, Woods Hole, Massachusetts.

Additional species:

S. ferox, N. A. Cobb, n. sp., with characters of genus and as indicated in key. $\frac{1.2\ 3.8\ 11.\ M\ 94.}{2.1\ 2.2\ 2.3\ 2.4\ 2.2}$ 3.3 mm.

Habitat: Penzance, Woods Hole, Massachusetts.

S. denticulata, N. A. Cobb, n. sp., with characters of genus and as indicated in key. $\frac{1.1\ 4.7(?)\ 11.\ ^{14}48'^{12}\ 91.2}{2.6\ 2.7\ 3.2\ 3.2\ 1.9}$ 2.2 mm.

Habitat: In sand, Woods Hole, Massachusetts.

Key to Species of *Synonchiella.*

Cephalic setae ± 1 head-width long; nema over 3 mm.; ♂ supplements 23 *S. ferox*

Cephalic setae 1/5–1/4 head-width long; nema under 2.5 mm.; ♂ supplements 8 or not known.

Amphid 1/2 head-width; cephalic setae of equal length; sublateral subcephalic setae 4; ♂ supplements 8 ..... *S. truncata*

Amphid 1/4 head-width; cephalic setae unequal, subcephalic setae 0; ♂ not known, ♀ ..... *S. denticulata*

14. *Dasylaimus*, N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Chromadorinae). Striae resolvable into fine dots; wings two, scalariform. Setae none. Amphid obscure, probably near lips. Pharynx more or less chromadoroid, denticulate, vestibule more finely so, other armature lacking. Oesophagus with pharyngeal and cardiac swellings, the latter three-parted by breaks in the musculature. Spinneret present. Anterior ovary doubly reflexed, posterior apparently not functional. This genus differs from *Euchromadora* in that there is no onchium and that the entire pharynx is denticulate.

Type: Dasylaimus nudus.

Dasylaimus nudus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.7\ 9.0\ 18.8\ {}^{224}51'.{}^{18}\ 88.}{2.5\ 4.1\ \underline{4.5}\ 5.5\ 2.8}$ 1 mm. Dots of cuticle continued among the scalariform markings of the wings, except on head, where the dots are larger. Vestibule with but little trace of radial striation. Denticles in the pharynx itself in five or six rows, twelve to twenty in each row, but in the vestibule a much larger number. Pharynx about as deep as head is wide, rather flat-bottomed, and posteriorly half as wide as base of head. The chief indication of amphids the absence of cuticular dots on a small area a little in front of the ending of the wings. Tail conoid, then cylindroid in posterior two-fifths, where it is about one-fifth as wide as at anus. One female specimen.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachuetts.

15. *Denticulella*, N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Chromadorinae). Cuticle rather thin, striae of dots, somewhat altered on the lateral fields, but without wings. Pores none. Papillae apparently two circlets of six; cephalic setae six (four?). Amphid transverse, slit-like, at lips. Lip region more transparent, vestibule twelve-ribbed. Dorsal onchium relatively small and acute, opposed by numerous minute, somewhat forward-pointing denticles. Pharyngeal bulb pronounced, stronger and twice as long dorsad, set off by slight constriction. Cardiac bulb pyriform, valvate. Tail conoid, spinneret present. Ovaries probably two, reflexed (specimen young). Spicula two, arcuate; gubernaculum parallel, without apophysis. Male supplements chromadoroid.

Genus distinguished from *Hypodontolaimus* by the smaller more acute onchium and the denticulate pharyngeal wall.

Type: D. pellucida.

Denticulella pellucida, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.1\ 9.\ 14.\ {}^{85}M\ 83.}{1.9\ 2.9\ \underline{3.2}\ 3.2\ 2.7}$ 0.94 mm. The dots of the cuticle are elongate on the lateral fields; on the neck sometimes a faint "basketwork" effect. Amphids about one-fifth width of lip region. Cephalic setae three-fifths to two-thirds head-width long. Four setae on the neck, about one and one-half head-widths back, longer than the cephalic setae. Onchium reaching one-third the way to the anterior margin. Denticles about fifty, largest about one micron high. Pharyngeal bulb almost as long as head is wide. Spinneret conoid, truncate, with faint cuticular dots, and armed with two or more dorsally submedian setae. Somatic setae inconspicuous, rather numerous. Caudal setae small, inconspicuous, at least six or eight. Spicula tapering, at widest one-fourth as wide as body, one and one-third times as long as anal body diameter. Proximally, the walls of the spicula becoming thinner and the dorsal element slightly the longer. Gubernaculum one-half as long as spicula, partially surrounding them. Male supplements a series of eight, extending four body diameters from anus, the refractive portion of each nearly as deep as wide.

Habitat: Humus at summit of Devil's Foot Island, Woods Hole, Massachusetts.

16. *Nygmatonchus,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Chromadorinae). Cuticle thick, striae on neck of "basket-work" type, on body consisting of dots which fade out towards the middle of the body. Wing single, prominent. Lips six, separate; lip region "knobby." Amphid large transverse slits about opposite base of pharynx. Cephalic setae ten, inconspicuous, at base of lip region; no other setae except on tail. Pharynx cyatholaimoid, dorsal onchium rather large. Oesophageal swelling pyriform, confluent, faintly valvate. Male tail arcuate, diminishing rapidly, then conoid; spinneret long, chromadoroid. Preanal cuticle slightly thickened in male, supplementary organs absent; postanally a structureless looking cuticular shield, behind which the cuticle is again thickened. Spicula two, equal. Pair of telamons distinct, contours in front of spicula, and laterad; faint indications of gubernacular pieces behind the spicula.

Genus resembling *Rhips* as to pharynx and amphid, but differing in the rough lip region, in cuticular markings and wing, and in the spicular apparatus.

Type: N. scriptus.

Nygmatonchus scriptus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.\ 9.1\ 17.0\ M\ 83.}{2.1\ 3.1\ 4.5\ 4.5\ 4.3}$ 0.7 mm. Near head, cuticle occupying one-third radius, near middle one-eighth. Largest cephalic setae about one-sixth corresponding head diameter. Amphid about as wide as one of the annules, and five times as long as wide, *i.e.,* about two-thirds as wide as that part of head. Excretory pore apparently just behind nerve ring. Male tail diminishing in anterior fourth to one-half anal width. Caudal setae scattered, two near base of spinneret. Spicula close together, somewhat longer than anal body diameter, and more nearly at right angles to body axis than is common; arcuate at ends but straight through the middle, where they are one-eighth as wide as base of tail. Telamon pieces one-half as long as spicula; faint gubernacular pieces perhaps about one-half as long as spicula.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachusetts.

17. *Nunema,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Chromadorinae?). Cuticular striae of dots, with rather numerous wings of V-shaped markings. Cephalic setae 4, cervical setae on anterior three-fourths of the neck in two ventral submedian rows of 6 each. Amphid a circular area marked only by absence of cuticular dots. Outer margin of lip region scalloped or lobed, with very fine longitudinal striations. Pharynx cyathiform then prismoid, with 3 apopyses resembling those of *Halichoanolaimus,* but close together and without denticles. Oesophagus cylindroid, without swelling. Tail convex, conoid then cylindroid. Spinneret tubular, about half as long as tail. Ovaries 2, reflexed.

Type: N. nanum.

Nunema nanum, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.4\ (?)14.\ (?)27.\ '61'.\ 89.}{5.5\ (?)6.9\ (?)7.3\ 7.3\ 5.5}$ 0.9 mm. Wings 12–18 on body, ceasing near terminus of tail where there are about 4. Cephalic setae one-fourth as long as head is wide. Amphidial area one-half head-width from anterior extremity, and about one-eighth as wide as head. Caudal glands close-packed in anterior half of broad tail, ampullae distinct.

Habitat: Cuttyhunk Mud Hole, near Woods Hole, Massachusetts.

Family DESMODORIDAE

18. *Neonyx,* N. A. Cobb, n. g.

Diagnosis: Chromadoridae (Desmodorinae, Fil.). Cuticular striae plain, often anastomosing, especially on neck and tail. Wings or flat lateral cuticular

elevations usually present. Pores none. Labial papillae or setae 6, setae on head in several circlets, numerous, often jointed. Amphids near lips, monospiral or somewhat more. Lips folding radially, forming vestibule, which may thus appear striated longitudinally. Pharynx shallow, walls thick and finely denticulate, continued backward as a narrow cavity nearly filled by the dorsal onchium. Total depth of pharynx about equal to head-width. Onchium somewhat spear-like, less so than that of Onyx, which it resembles; its apex nearly axial. Cardiac bulb large, cylindroid, obscurely divided into three parts. Tail conoid, spinneret conoid, truncate, without annules. Spicula 2, arcuate; gubernacular pieces parallel. Male with prenal thickening of ventral cuticle, supplementary organs a series of innervations in this thick area.

Genus differing from Desmodora and Acanthopharynx in that cuticular markings are continued on to the head, the cephalic setae are differently arranged, the pharynx is denticulate, the cardiac bulb is much longer, and the preanal cuticle is much thickened in the male.

Type: N. cancellatus.

Neonyx cancellatus, N. A. Cobb, n. s.

Diagnosis: With characters of genus.

$$\frac{2.6\ 7.\ 17.\ {}^{24}54.{}^{23}\ 93.6}{3.1\ 3.8\ 4.4\ 4.7\ 2.5}\ 1.3\text{ mm.}\qquad \frac{2.5\ 7.1\ 17.\ {}^{70}M\ 93.6}{2.7\ 2.9\ 3.3\ 3.8\ 2.7}\ 1.3\text{ mm.}$$

Cuticle rather thick, lateral cuticular elevations flat, present through middle of body. Annules coarsest on neck, anastomosing towards ends of body, somewhat oblique on tail; retrorse on posterior portion, the reverse anteriorly. Amphid monospiral. Circlets of setae on head of increasing length, difficult to count but apparently 8 to each circlet. Vestibule formed by folding of lips, anterior pharynx with 100–200 denticles, posterior narrow, nearly filled by base of dorsal onchium, which is free on dorsal side for 1/2 its length. Pharyngeal swelling slight, confluent. Cardiac bulb 2/3 as wide as neck, non-valvate, divided into 3 parts, middle the shortest; cardiac constriction deep. Vulva occupying about 5 annules. Ovaries 2, reflexed. Tail conoid, arcuate, caudal glands opposite and in front of anus; spinneret truncate, nonstriate. On male, ventrally submedian rows of setae from a little in front of spicula to past middle of tail, 12 at least in row. Other caudal setae 20–30. Spicula finely striated, tapering, widest near proximal end, 1¼–1½ times as long as anal body diameter and 1/7–1/4 as wide; gubernaculum thin, 2/3 as long as spicula and less arcuate. Male supplements mere innervations, about 12 in ventral cuticular "wing" or thickening.

Habitat: Sandy beaches, Woods Hole, Massachusetts.

Neonyx campycoma, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.1\ 7.9\ 15.\ M\ 93}{2.3\ 3.1\ 3.3\ 3.3\ 2.6}$ 1.8 mm. Wing single, narrow, extending from middle of neck to near tail. Anastomosing of annules on head, near lips, forming a reticulum with elongated meshes, often oblique. Cephalic setae 10, unequal, longest 1/2 as long as lip region is wide; setae of subcephalic and cervical circlets longer, constricted at base, jointed. Amphid 1/3 as wide as head, at level of lateral setae. Vestibule about 1/4 as wide as head, anterior (denticulate) part of pharynx not much wider, with walls about 1/3 as wide as cavity. Cardiac bulb occupying posterior half of neck, 5/6 as wide as neck. Caudal glands in anterior half of tail. Pre- and post-anal setae larger than somatic, equalling body radius, 16 to 18, ventrally submedian. Anal cuticle specialized, as if annules ended and projected, forming cuticular papilla-like structures. Spicula a little longer than anal body diameter, and about 1/5 as wide, tapering, faintly cephalated; gubernacular pieces modifications of cloaca. Innervations in ventral thick cuticle about 12, anterior one about 5 anal body diameters in front of anus.

Habitat: Beach sand on south shore of Martha's Vineyard, near Woods Hole, Massachusetts.

Neonyx alatus, N. A. Cobb, n. sp.

Diagnosis: With the characters of the genus. Cuticle rather thin, head with minute conspicuous dots; wings beginning opposite cardiac bulb, very pronounced, somewhat scalariform, 1/15 as wide as body. On female, wings cease behind vulva, appearing again near anus. Cephalic setae at anterior borders of amphids, 1/3 as long as base of lip region, labial 1/2 this length. Next 4, one on each side of posterior part of amphids. Subcephalic 6, longer, as are the submedian cervical and somatic cetae. Cardiac swelling about 2/5 as long as neck, 3-parted, anterior part the smallest. Caudal glands somewhat in front of anus. Base of spinneret 1/3 as wide as base of tail. Caudal setae larger and longer in male. Spicula rather uniform, cephalated by expansion, about twice as long as anal body diameter, at middle 1/10 as wide as body diameter; gubernacular pieces 1/2 as long as spicula, slender, not very conspicuous. Male supplementary organs about 10 innervations in ventral, transparent, elevated, cuticular area in front of anus.

Habitat: Among pebbles, salt marsh, Penzance, near Woods Hole, Massachusetts.

19. *Sigmophora,* N. A. Cobb, n. g.

Diagnosis: Desmodoridae (Desmodorinae). Cuticle with striae (except on head) which are very fine, plain or consisting of exceedingly fine dots, not altered on lateral fields. Amphid monospiral. Setae on head numerous, arrangement difficult to determine; apparently two inner circlets each of 6, and three circlets each of 4 longer but still short setae near amphids. Cervical setae mostly sublateral and submedian, on anterior half of neck. Vestibule striated only by folding of 6 double, protrusile lips, reaching almost to apex of dorsal onchium, which projects into the very shallow denticulate anterior chamber of the pharynx. Onchium well-developed, its faintly S-shaped ventral contour axial or ventrad of axis; anterior contour curved. No other onchia seen. Posterior pharynx narrow, changing rather definitely to oesophagus lumen. Pharyngeal bulb confluent, cardiac swelling elongate, strongly muscular. Ventriculus apparently present. Tail conoid, setose, spinneret present. Ovaries 2, reflexed. Spicula long, slender, distally arcuate, cephalated by expansion. Gubernaculum slight, parallel, without apophysis. Male supplements numerous, preanal, mid-ventral, well cuticularized, strongly sigmoid or sickle-shaped, probably protrusile. Testes apparently 2. Genus separated from other Desmodorinae by the arrangement of the cephalic setae, the structure of the cuticle, and the single row of sigmoid male supplementary organs.

Type: S. rufum.

Sigmophora rufum, N. A. Cobb, n. sp.

Diagnosis: With characters of genus.

$$\frac{1.5\ 7.3\ 13.\ {}^{39}57^{39}\ 92.3}{2.7\ 2.9\ \underline{2.9}\ 3.1\ \ 2.0}\ 1.3\ \text{mm.}\qquad \frac{2.0\ 7.0\ 12.4\ {}^{48}\text{M}\ \ 91.1}{2.6\ 2.8\ \ 2.9\ \ 3.1\ \ 2.7}\ 1.5\ \text{mm.}$$

Amphids one-third to two-fifths as wide as head, one-fifth to one-fourth head-widths from anterior end. Longest setae two-fifths as long as head is wide, labial one-third this length. Denticles minute, 100–200, lining the wall of the anterior pharyngeal chamber, which is two-fifths as wide as head and one-third as deep as wide. Onchium about as high as width of base of its free part. Intestine often orange-red. Spinneret acute, conoid, unstriated, wall thickened through middle part. Spicula one-twelfth to one-tenth as wide as anal body width, and three times as long,—almost as long as tail. Supplementary organs 15 or more, one-fourth as long as body is wide and extending over a distance about four times as long as tail.

Habitat: Beaches, Woods Hole, Massachusetts.

20. *Desmodorella,* N. A. Cobb, n. g.

Diagnosis: Desmodoridae (Desmodorinae Fil.). Body slightly narrower behind neck, obese posteriorly. Cuticle rather thick, annules rather fine, anasto-

mosing somewhat towards ends of body, and interrupted by numerous, discontinuous wings irregular in width. Head from behind amphid without annules, but finely and irregularly reticulate or punctate. Amphid multispire. Labial setae 6, not always seen, cephalic 4 (6?), subcephalic 4, all short. Cervical and somatic setae dorsal and ventral, usually numerous. Vestibule 12-ribbed or striate by folding of lips. Interior part pharynx cyathiform (somtimes denticulate), dorsal onchium projecting into it; posterior part conoid. Pharyngeal swelling faint, cardiac bulb ellipsoidal to broad-pyriform, apparently sometimes valvate. Tail conoid, spinneret sometimes 1/4 as long as tail. Ovaries 2, reflexed. Spicula 2, slender, 3–5 times as long as anal body diameter, faintly cephalated. Preanal subventral spine-like setae on male in groups of 3–4 (anteriorly 5–6), each group with one or more ventral setae twice as long; no other male supplementary organs.

The genus is distinguished from Desmodora by the body form, the conspicuous alteration of the cuticle on the head, and the groups of thorn-like ventral preanal setae of the male.

Type: D. cephalata.

Desmodorella cephalata, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{3.0\ \ 11.2\ \ 18\ \ {}^{10}67.{}^{15}\ 91}{3.2\ \ 4.3\ \ 4.4\ \ 7.2\ \ 3.3}$ 0.8 mm. $\frac{2.0\ 9.5\ 18.8\ M\ 89}{2.8\ 4.2\ 3.6\ 3.1\ 3.8}$ 0.8 mm. Annules finer towards end of body. Labial setae 6. Amphid spiral of about 2 winds, about half as wide as head, and placed near anterior extremity. Opposite onchium, a cavity on ventral side of pharynx, apparently not denticulate.

Habitat: Cuttyhunk Mudhole and Menemsha Bight, Woods Hole, Massachusetts.

21. *Pristionema,* N. A. Cobb, n. g.

Diagnosis: Desmodoridae (Ceramoneminae). Cuticle thick, plain on head. Wings 8, strong, projecting. Annulation (annules over 700) beginning suddenly, about at posterior end of large "shepherd's crook" amphid (longer limb ventrad) and ending on spinneret. Cephalic setae 8, in 2 circlets. Pores 0. Pharynx absent. Oesophagus widening toward base, without bulb, and overlapping on to intestine. Tail tapering. Spinneret unusually long and blunt. Spicula 2, equal, short, arcuate; gubernacula straight. Preanal supplements absent.

Genus much like Ceramonema, but larger, presenting over 700 annules instead of under 300, and apparently lacking lateral cephalic setae which are present in Ceramonema. It differs from Pselionema Cobb (= Steineria Fil.) in these respects and in absence of any suggestion of an onchium.

Type: P. octalata.

Pristinonema octalata, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{0.5\ 3.8(?)\ 7.7\ M\ 93.9}{0.6\ 0.8(?)\ 0.8\ 8.9\ 0.8}$ 3.3 mm. Wings 8, occupying as much of the circumference as do the grooves between them and extending onto head and spinneret beyond the annulation. Annules extending onto wings with a beautiful "tiled" appearance. Contour of wings plain. Cephalic setae 3/5 as long as head is wide. Amphid ensconced between 2 wings, which give way a little to make room for it. Nerve ring somewhat oblique. Spinneret 1/5 as long as tail. Spicula but little longer than anal diameter, gubernacula 2/3 this length, at an angle of about 45% with body axis. Ventro-submedial rows of setae on tail extending to spinneret. Testes probably 2 opposed, spermatozoa fusiform, 1/4 as long as body is wide. Female not seen.

Habitat: Sand at 5 fathoms, Vineyard Sound, Mass.

22. *Pteronium,* N. A. Cobb, n. g.

Diagnosis: Desmodoridae (Richtersiinae). Body widest just behind lips, tapering slightly thence to terminus. Transverse striae of the cuticle resolvable

into minute dots, interrupted by many longitudinal ridges, most numerous on neck, where fishbone-like markings are apparent. Lip region with fine longitudinal striations. Amphid very small, probably behind lips, transverse spiral, width (anterior to posterior) less than one-twelfth head-width. Inner cuticular thickenings of the three lips about 18. Pharynx conoid when open. Genus closely resembling Richtersia and Richtersiella, but differing in shape of body, shape of pharynx and the much smaller amphid.

Type: P. obesum.

Pteronium obesum, N. A. Cobb, n. sp.

Diagnosis: With the characters of the genus. Longitudinal ridges 12 on most of body, to 26 on neck. Setae on head 12, in 2 circlets, about 1/6 as long as front of head. Cervical and somatic setae somewhat longer. Tail tapering more rapidly, striae ceasing on spinneret. Single young specimen seen.

Habitat: Between Martha's Vineyard and Woods Hole, Mass.

Family TYLENCHIDAE

23. *Halenchus,* N. A. Cobb, n. g.

Diagnosis: Tylenchidae (Tylenchinae). With the characters of Tylenchus, but with the oesophageal bulbs vestigial, the junction of oesophagus and intestine more or less indefinite, and the terminus of the tail hooked towards ventral side. Differs from *Neotylenchus* in latter two characters and in that the lip region is divided into six instead of eight sectors. Differs from *Hexatylus* in having 3 and not 6 bulbs at base of spear. Spear smaller in male. Differs from all three also in being marine.

Type: H. fucicola (de Man., 1892) N. A. Cobb.

Synonym: Tylenchus fucicola de Man., 1892.

Other species: H. mediterranea (Micol., 1922) N. A. Cobb.

Halenchus fucicola (de Man., 1892), N. A. Cobb, n. comb.

Diagnosis; Halenchus:

$$\frac{1.4\ 8.4\ 18.5\ {}^{44}\text{–}64\ \ 92.3}{0.9\ 1.5\ \ 1.8\ \ \ 2.2\ \ 1.1}\ 1.3\text{ mm.}\qquad \frac{1.5\ 9.8\ 18.5\ {}^{80}\text{–M}\ \ 92}{1.1\ 1.6\ \ 1.9\ \ 2.1\ \ \ 1.8}\ 1.2\text{ mm.}$$

In the bladders of Fucus (Ascophyllum). Specimens collected at Woods Hole, Massachusetts, differed only in having neck 15%.

24. *Rhabdonchus,* N. A. Cobb, n. g.

Diagnosis: Tylenchidae (Allantoneminae): Striae very fine, materially altered on lateral fields by numerous wings. Head more or less swollen, with 4 lips forming a hemispherical protuberance at edge of which are small oval amphids. Dermal appendages none. Pharynx distinct, behind lips, partly contained in massive pharyngeal bulb. Spear long, simple, plain, cylindrical, hollow, with faint guide; opening very oblique. Oesophagus with vestigial valvate median bulb. Oesophageal glands probably 3, ducts of 2 emptying at median bulb, one farther forward. Intestine arising very gradually from oesophagus. Anus and rectum reduced, usually indistinguishable. Excretory pore behind nerve ring. Vulva behind middle; ovary one, outstretched, anterior. Spinneret and caudal glands none. Tail conoid, tapering from in front of anus.

Type: R. cephalatus, n. sp.

Rhabdonchus cephalatus, N. A. Cobb, n. sp.

Diagnosis: With characters of genus. $\frac{1.5\ 8.7\ 12.\ \ –69.\ \ 86}{1.7\ 1.7\ \ 2.\ \ \ \ \ 2.1\ \ 1.2}$ 1.9 mm. Width of amphid about 1/5 lip region. Spear 24 microns. Wings 14, somewhat quadruple, occupying 1/8 body width. Nerve ring very oblique.

Habitat: Body cavity of beetle, *Paromalus aequalis* (Say), occurring under bark of dead tulip tree, near Washington, D. C.

IN MEMORIAM

Frederick Fülleborn (1866–1933)

The death of Geh. Medizinalrat Prof. Dr. Friedrick Fülleborn on September 9th from a sudden heart attack was a great loss to tropical medicine and parasitology. In 1900 Dr. Fülleborn was called to head the department of tropical medicine in the Institut für Schiffs- und Tropenkrankheiten, which was founded in that year, and in 1930 he became director of this institute. His thirty-three years of achievement in the Institute as physician, teacher, investigator, and administrator gave him world wide recognition as a leader in his chosen field. As a student he came under the influence of Rudolph Leuckart and there acquired the interest in the biology and pathology of animal parasites which determined the researches of his later years. He was a brilliant and tireless investigator and was one of the first to emphasize the experimental attack in the study of animal parasites. His published researches of over one hundred titles, especially in helminthology, will give him a lasting place in the field of parasitology. His work was given wide recognition and he received many honors from his own and other countries. He was well known to American workers, having visited the United States in 1924, and was a foreign honorary member of the American Society of Parasitologists.

Dr. Fülleborn was greatly loved by his associates and all who had the privilege of knowing him admired him for his keenness of mind, his kindliness and the nobility of his character. He was a truly great man. His loss will be keenly felt but his life and work will be a continued inspiration to those who knew him personally and to the workers in the field to which he devoted his life.

An account of Dr. Fülleborn's life and work will appear in a later number of the Journal of Parasitology.

Nelson Caryl Davis (1892–1933)

Dr. Nelson C. Davis, a member of the field staff of the International Health Division of the Rockefeller Foundation, died at Bahia, Brazil, on October 21, 1933. Dr. Davis received his education in the University of California, obtaining his A.B. degree from that institution in 1917 and his M.D. in 1921. Soon after the completion of his medical work, Dr. Davis joined the field staff of the International Health Division of the Rockefeller Foundation and continued with this organization up to the time of his death. His first assignment was in connection with the

hookworm campaign in Brazil and he later engaged in malaria work in Brazil and the Argentine. When the International Health Division undertook extensive investigations on yellow fever in Brazil Dr. Davis was transferred to this project and later was placed in charge of the yellow fever research laboratory in Bahia. While on study leave he worked at the School of Hygiene and Public Health of the Johns Hopkins University, receiving the Dr.P.H. degree from that institution in 1931.

Dr. Davis combined in an unusual degree research and executive ability. He was an extremely hard worker and was able to find time in spite of his administrative duties to carry on researches on problems connected with the projects in which he was engaged. He has published a number of papers in the field of parasitology first on hookworm disease and later on malarial epidemiology and control including a series of systematic papers on South American mosquitoes. His more recent publications have been on the yellow fever problem including possible transmission by insects other than the common vector and on the relation of the virus of the disease to the mosquito. His promise for the future in research was great and his death came in the midst of his period of greatest activity. Dr. Davis was a man of very pleasing personality and was liked and admired by his associates. He will be greatly missed by his many friends in this country and in South America.

PROCEEDINGS OF THE HELMINTHOLOGICAL SOCIETY OF WASHINGTON

The One Hundred and Fifty-fifth Meeting

The one hundred fifty-fifth meeting was held April 15, 1933, in the United States National Museum. Dr. Chitwood presiding.

Papers were read as shown below.

L. A. SPINDLER, Secretary.

1. The development of the swine stomach worm, HYOSTRONGYLUS RUBIDUS, *in guinea pigs.* J. E. ALICATA.

On December 23, 1932, each of two guinea pigs was given 25 infective larvae of *Hyostrongylus rubidus by mouth.* From one of these animals, killed 5 days after experimental infection, there were recovered from the stomach, by means of the Baermann isolation apparatus, 2 exsheathed third-stage larvae of *H. rubidus.* One of these larvae showed the following measurements: length, 780 μ; width, 24 μ; esophagus, 179 μ; genital primordium, 307 μ from the anterior extremity; tail, 72 μ. In the case of the other pig, killed 25 days after experimental infection, 2 specimens of *H. rubidus* were found in the stomach. One of these specimens was an adult female containing segmented eggs in the uteri, and the other was a fourth-stage female larva. This larva showed the following measurements: length, 2.12 mm.; width, 40 μ; esophagus, 342 μ; vulva, 387 μ from the tip of the tail; tail, 120 μ. The feces of this guinea pig cultured in animal charcoal, yielded, after 8 days, infective larvae of *H. rubidus.* No lesions were noted in the stomachs of these two guinea pigs.

2. SPIROCHAETA LAGOPODIS *in the blood of a willow grouse.* E. A. ALLEN.

A spirochaete, *Spirochaeta lagopodis* Fantham, was found in the blood of a willow grouse, or ptarmagin, *Lagopus lagopus* from Quebec Province, Canada. The blood smears were made by Dr. D. A. Derby, of the Quebec Zoological Society. So far as is known, this is the first time that this parasite has been reported from America. Fantham (1928) found it in grouse in Scotland and Margit Haaland (1921 and 1927) collected it from the willow grouse of Norway. *S. lagopodis* appears to have both longitudinal and transverse fission, as has been described by Haaland.

3. Observations on the life history of TETRAMERES PATTERSONI. ELOISE B. CRAM.

Eggs of this nematode, taken from the glandular stomach of a bobwhite quail (*Colinus virginianus*) were fed to two species of grasshoppers (adults of *Melanoplus femurrubrum* and nymphs of *Chortophaga viridifasciata*) and to cockroaches (*Blattella germanica*). Larvae of *T. pattersoni* developed in all three of the arthropods; 24 days after feeding the eggs, third stage characteristics appeared fully developed and the larvae were encysted in the muscles, including those of legs and head, and in the mesenteries of the body cavity. The cysts were loose or only feebly attached to the tissues; each cyst contained 1 to 3 coiled larvae. A cyst containing 1 larva measured 560 μ by 370 μ. The third stage larva therein was 1.4 mm. long, mouth capsule 21 μ deep, first part of esophagus 176 μ, second part of esophagus 440 μ long, anus 137 μ from tail end. The tail end had a small protuberance, which on some larvae was comparatively flat and button-like, on others was elongated rod-like, but in either case narrower than the end of body proper, and bearing on it several very minute spines. Appearance of tail end was thus very different from those of the third stage larvae of *T. fissispina* and *T. americana,* two other species for which the life histories are known. After periods of 24 to 61 days of development in the arthropod intermediate hosts, larvae of *T. pattersoni* were fed on several occasions to 8

chickens, 2 turkeys, a pigeon and a duck, but in no case was development of the adults accomplished. Unfortunately no quail were available for feeding experiments. Another factor which may have been unfavorable for development of the nematodes was the age of the birds, since the turkeys, pigeon, and duck were all adult birds; the chickens, however, were only 2 to 4 weeks old when fed the larvae.

4. Observations on the life history of SEUROCYNREA COLINI. ELOISE B. CRAM.

Eggs of this nematode, taken from the glandular stomach of a bobwhite quail (*Colinus virginianus*) were fed to two species of grasshoppers (adults of *Melanoplus femurrubrum* and nymphs of *Chortophaga viridifasciata*) and to cockroaches (*Blattella germanica*). Third stage larvae were developed in the grasshopper nymphs and in the cockroaches, the former being a new host record, the latter having been previously reported. Development did not take place in the adult grasshoppers, *Melanoplus femurrubrum,* these negative results being similar to those previously reported for this species. Attempts to infect 2 turkeys (adults), a pigeon (adult), and 2 chickens (young chicks) were unsuccessful. Description of the larvae of this species has been published in an earlier study. The following comparative observations were made on third stage larvae of *S. colini* and *T. pattersoni* of the same age, developed simultaneously in a specimen of *Chortophaga viridifasciata*:

Seurocynrea colini	*Tetrameres pattersoni*
3.3 mm. to 3.7 mm. long	1.4 mm. long
nonencysted	encysted
very active when released	never very active
tail blunt, with bulbous swelling of greater diameter at end	tail finely tapered, with small protuberance of lesser diameter at end
absorbs gentian violet quickly	do not absorb gentian violet

5. The white-footed mouse, PEROMYSCUS LEUCOPUS NOVEBORACENSIS, *a new host for* ENTOSIPHONUS THOMPSONI *Sinitsin,* 1931: BRACHYLAEMIDAE. WENDELL H. KRULL.

Nine out of 41 mice, *P. leucopus noveboracensis,* caught during March in the vicinity of Beltsville, Maryland, were infested with mature specimens of *E. thompsoni.* No mouse harbored more than 3 flukes.

6. New hosts for HAEMATOLOECHUS COMPLEXUS (*Seely,* 1906) *Krull, n. comb.* WENDELL H. KRULL.

Rana clamitans has been found to be a new host for *Haematoloechus complexus.* The snail *Pseudosuccinea columella* Say, has been determined as a first intermediate host, and the dragonflies, *Sympetrum vicinum, Pachydiplax longipennis* and *Holotania* (*Libellula*) *incesta,* have been determined as second intermediate hosts of this parasite. The snail and the dragonfly, *H.* (*L.*) *incesta* have been raised from eggs and infected in the laboratory. (Details of the life history are being published elsewhere.)

7. The opossum, DIDELPHIS VIRGINIANA VIRGINIANA *Kerr, a new host for* BRACHYLAEMUS SPINOSULUM (*Hofmann,* 1899). WENDELL H. KRULL.

Blochmann (1892) fed *Helix hortensis,* the kidneys of which were infested with a Cercariaeum, to a hedgehog, *Erinaceus europaeus,* and upon subsequent examination a pathological condition of the intestine was found which Blochmann attributed to the numerous specimens of *Distomum caudatum* Linstow, 1873 (now considered to be a synonym of *Brachylaemus helicis* (Meckel, 1846)) which it contained. Hofmann (1899) also conducted some uncontrolled experiments with snails, *Helix* spp., and hedgehogs and claimed that *Cercariaeum helicis* developed into *Distomum leptostomum* and that *C. spinosulum* (species

name recorded as *spinulosum* by subsequent authors, including Stiles and Hassall, 1908; Witenberg, 1925; Werby, 1928; Dickerson, 1930; Sinitsin, 1931) developed into *Brachylaemus spinosulum*; the former species is now considered to be a synonym of *Brachylaemus helicis*. The above experiments are, of course, inconclusive but the experiment described in the present paper, apparently supports Hofmann's conclusion that *C. spinosulum* Hofmann, 1899, develops into *Brachylaemus spinosulum*. Recently a large number of snails, *Helix hortensis*, from Thuringen, Germany, were examined for metacercariae. Twenty-two metacercariae identified as *Cercariaeum spinosulum* were recovered, of which some were used for feeding experiments, others were stained and mounted for study, and one was studied in the living condition. The above named metacercaria was originally described by Hofmann from species of *Helix*, including *H. hortensis*. Twelve of the metacercariae, *Cercariaeum spinosulum*, which were recovered from the snails, were fed by means of a pipette to a half grown opossum, *D. virginiana virginiana*. A post-mortem examination of this animal was made 49 days later, and 4 adult flukes were recovered from the intestine. The opossum was one of a litter of 6, about the size of house mice, still in the pouch of the mother when caught. This precludes any possibility of an extraneous infection even though the same or a closely related species of *Brachylaemus* occurs in this vicinity (Beltsville, Maryland). Furthermore, several fecal samples from each of these opossums, taken after they were separated from their mother, were negative for eggs of this parasite. Fecal samples from the experimental opossum taken on the 2, 4, 6, and 11 day after infection were negative but those taken on the 45, 46, and 47 day were positive for eggs of *B. spinosulum*. A comparison of the metacercaria with the description and figure given by Hofmann for *Cercariaeum spinosulum* did not reveal any differences other than the spines which were not as large in all specimens as indicated by this author. In the adult flukes the vitellaria extend anteriorly to the level of the posterior margin of the acetabulum in 2 specimens, and midway in the other 2 while in Hofmann's figure they extend to the anterior border. All these differences are, however, considered by the writer to be of minor significance but are pointed out because the work of Dickerson (1930), Hofmann, Joyeux, Baer and Timon-David (1932), McIntosh (1932), Sinitsin (1931), Werby (1928), Witenberg (1925), and others, shows that species in the family Brachylaemidae are exceedingly difficult to determine.

8. Infections of the white-footed mouse PEROMYSCUS LEUCOPUS NOVEBORACENSIS, *with* FASCIOLA HEPATICA *Linn.* WENDELL H. KRULL.

Several laboratory raised white-footed mice have been given cysts of *Fasciola hepatica* and all of them became infected. All the infected mice, with one exception, died on or before the 38th day after the cysts were administered. The largest fluke recovered from the mice showed a few ova in the uterus. The mouse which survived was examined 3 months after experimental infection. At this time the lobe of the liver which harbored the remains of a fluke was found to be almost destroyed. Several mice are each being given a single cyst in order to determine whether a minimum infection will arrive at the egg producing stage. As a consequence of the above experiment it is interesting to speculate as to what the situation is in regard to the mice of this species in fluke infested areas.

The One Hundred and Fifty-sixth Meeting

The one hundred fifty-sixth meeting was held May 20, 1933, in the United States National Museum. Dr. W. W. Cort presiding.

Papers were presented as shown below.

L. A. SPINDLER, Secretary.

1. Probabilities of fortuitous coincidence in the experiments previously reported on the control of poultry coccidiosis by the chemical treatment of litter. JUSTIN ANDREWS.

Experiments on this subject previously reported in the March issues of the *American Journal of Hygiene* (17: 466–490) and *Poultry Science* (12: 133–140), have received some criticism on account of the possibility of chance occurrence of experimental treatment and survivorship. As the numbers are sufficiently great, four-square tables comparing the observed and chance coincidence of such attributes as the presence or absence of pen treatment and the survivorship and mortality per pen have been prepared. From the computed X^2, the probability of the association being a purely fortuitous one can be determined. In the 2 "Dirty Pens" of the first experiment described, the probability of chance being the factor which determined the coincidental relationship of toxiting and mortality either from all causes or that associated with coccidiosis is of the general order of one in more than four hundred billion. In the "Clean Pens," the probability of chance association is of an entirely different order. Considering the final total mortality from all causes, the odds are 1 in 10 that chance might have operated to cause the observed concurrence. This is in accordance with the conclusions previously expressed. Considering the mortality *with* coccidiosis, the chances are 143 to 1 that toxite caused a reduction in the death rate. In the second experiment, the results are similar to those obtained in the "Dirty Pens" of the first, namely, that pure chance might have produced the observed relationship between treatment and survivorship in one out of one and one-half or two million times.

The following table shows the exact figures of the probabilities due to chance in the Toxite field experiments.

Exp. I—Pens 3 and 4	X^2	x	P	Odds against chance occurrence
Toxite vs. Final Mortality			Less than	More than
a) All causes	103.0	10.1	.0000000000026	400,000,000,000 to 1
b) With coccidiosis ...	128.0	11.3	"	"
Toxite vs. Mortality after 3 weeks			Less than	More than
a) All causes	135.0	11.6	.0000000000026	400,000,000,000 to 1
b) With coccidiosis ...	101.0	10.0	"	"
Exp. I—Pens 1 and 2				
Toxite vs. Final Mortality				
a) All causes	2.8	1.7	.09	10.2 to 1
b) With coccidiosis ...	7.3	2.7	.007	143 to 1
Toxite vs. Mortality after 3 weeks				
a) All causes	3.7	1.9	.06	16 to 1
b) With coccidiosis ...	4.1	2.0	.05	21 to 1
Exp. II—Pens 5 and 6				
Toxite vs. Mortality				
a) All causes	12.3	3.5	.0005	2150 to 1
b) With coccidiosis ...	27.0	5.2	.000000459	2,000,000 to 1
Toxite vs. Mortality after 3 weeks				
a) All causes	7.3	2.7	.007	143 to 1
b) With coccidiosis ...	21.0	4.6	.00006	1,500,000 to 1

2. Chemical treatment of litter as an aid in the control of rabbit coccidiosis. JUSTIN ANDREWS.

Experiments were carried out to ascertain whether or not rabbit coccidiosis could be controlled by the same chemical litter treatment previously used and described as an aid in the control of poultry coccidiosis. This investigation was carried out on a commercial rabbitry situated near Westminster, Maryland. The proprietor, Mr. Ray C. Hook, supplied a number of the rabbits, the hutches, bedding, food, and management. All experiments were conducted on the same premises, consisting of a small isolated house, the interior of which was divided by a partition into 2 pens each 4 feet square. Straw was used for bedding. The chemical treatment employed was the same as that used in previously described

experiments with poultry coccidiosis. It consisted of spraying the litter once each week with a mixture of high-boiling coal-tar acids and light mineral oil (commercially known as Toxite). The chemical was applied with a household insecticide sprayer until the litter was moist in appearance. This required approximately one quart to 100 square feet of floor area. The rabbits were removed from the pens during the spraying process and were replaced as soon as the droplets had settled out of the air. The animals exhibited some signs of discomfort when placed on freshly sprayed premises, but this was never more than temporary. In the first experiment, the clean litter in each hutch was deliberately contaminated by stirring equal quantities of mixed species of rabbit oöcysts into the bedding. One pen was then sprayed and was similarly treated once each week thereafter; the other hutch received no treatment. A litter of two-weeks-old bunnies with their doe was placed within each pen. The pens were cleaned and supplied with fresh litter once each week. The animals were under observation for 35 days, at which time they were ready to be weaned and were removed.

Results were as follows: all of the rabbits in the treated pen lived throughout the experiment and appeared to be in excellent health. In the untreated hutch, one of the group of young rabbits was killed accidentally, and 3 of the others became acutely ill with a severe diarrhea during the second week. Two of these rabbits died, and, at autopsy, showed extensive hemorrhagic lesions in which the merozoites of coccidia were numerous. The second experiment was virtually a repetition of the first except that in lieu of contaminating the litter, one bunny in each of the 2 litters of 5 was inoculated with mature oöcysts by mouth. On the treated side, the infected bunny and one of its litter mates died with severe coccidial lesions; on the untreated side, the inoculated bunny was ill but survived its infection, whereas 2 of the uninoculated bunnies died as a result of coccidial infections. While the trend of these preliminary experiments indicated that the treatment was, on the whole, beneficial, it could hardly be considered conclusive. The following experiment was therefore designed using a larger number of rabbits in hope of obtaining more clear cut results. Thirty rabbits of weaning age, 6 to 8 weeks, were purchased from the rabbitry maintained by the Department of Immunology of the School of Hygiene and Public Health. While it cannot be claimed that these animals were free from coccidiosis, they had been maintained under conditions of exceptionally strict sanitation. Coccidiosis has not been clinically evident for a considerable period of time among the rabbits on this farm. The same pens used in the previous experiments were thoroughly cleaned. Fresh straw litter, to a depth of about 1 inch was placed on the floor of each pen. A quantity of rabbit manure removed from other houses was carefully mixed so that the oöcyst content was uniform throughout. Ten pounds of this mixture was stirred into the litter in each pen. One of the hutches was then treated and was sprayed once each week thereafter. The other pen received no treatment. The young rabbits were then distributed into the two pens as equally as possible according to their weight and appearance. Pens were cleaned once each week. Observations were carried on for 2 months. During the course of that time 5 rabbits died in the treated pen. All were infected with coccidia, but only 2 of them showed any special pathology due to coccidial parasitism. Two of the other 3 rabbits had died of pneumonia and one had apparently been smothered. The weight of the 10 survivors was 35 pounds. In the untreated pen all 15 of the rabbits had died by the end of the experiment. All these rabbits were infected with coccidia and in 11 of these, coccidiosis had been a prime or contributory cause of death. Three of the rabbits had died with pneumonia and one with a liver infection resembling miliary tuberculosis except that other organs were apparently not involved. In these 4 animals severe coccidial lesions were not evident. Probability tests indicate that the difference in mortality rates from coccidiosis in the treated and untreated pens were highly significant. It is believed that these findings are in harmony with the results obtained in the experiments with poultry coccidiosis and support the claim that mixtures of coal-tar

acids in oil applied to the litter at weekly intervals together with reasonable sanitation constitutes an effective aid in the control of rabbit coccidiosis.

3. Remarks on a list of host plants of the root-knot nematode, HETERODERA MARIONI (*Cornu* 1879) *Goodey* 1932. EDNA M. BUHRER.

A list of all the known plant hosts of the root-knot nematode, *Heterodera marioni* (=*H. radicicola* (Greeff, 1872) Muller, 1884; =*Meloidogyne exigua* Goeldi, 1887; =*Caconema radicicola* Cobb, 1924), is soon to be published. A rough estimate of the number of plants to appear on it reaches about 850 species. Such a list has not been compiled in this country since 1911 when Bessey published the names of 480 species and subspecies, using his own observations and previously published reports of investigators in different parts of the world. More recently (1931), the Imperial Bureau of Agricultural Parasitology in Winches Farm, St. Albans, England, published such a list containing 569 names. Inasmuch as crop rotation is the most practical method yet devised for controlling this nematode disease in the field, the value of such a list of plants susceptible to the disease is evident. By consulting the list, a grower can, to some degree, ascertain what plants he should not use in his rotation plan. Some of the host plants are of course only slightly attacked, especially if not grown in succession, and give desirable rotation crops if used in the proper way. The greatest difficulty in the compilation of such a host list lies in the correct interpretation of colloquial and common names of plants used to designate hosts and occurring in the literature of countries throughout the world. Other difficulties arise from the nomenclatorial standing of names as applied by various authors and from the difficulty of consulting the widely scattered literature references. It is planned that, as far as is possible, the common names, together with their proper Latin names, and their Latin synonyms (if such have been published as host plants) will be printed in one alphabetical series, differences in type being used to indicate the status of each name. The large number of host plants, which includes representatives of all major groups of the phanerogams but excludes the cryptogams, gives testimony to the parasitic ability of *H. marioni.* Its omnivorous character is most outstanding and rather unique, especially if the highly specialized type of its parasitism is considered. Unfortunately little is known at present concerning the exact morphological reactions of the various host types, and from a physiological point of view the interrelations between host and parasites are still very obscure.

4. MONONCHUS COBBI *Cassidy,* 1931, *as a variety of* MONONCHUS PARVUS *deMan,* 1880. GERTRUDE H. CASSIDY.

In 1893 Cobb described a new species of Mononchus which he named *Mononchus similis.* In 1907 the same author again described a new species different from the first, to which the same name *M. similis* was given. This error was corrected by Micoletzky in 1922 when he renamed this second species *M. cobbi.* However, in the same year (1922) Schneider named another new Mononchus species *M. cobbi,* which a few months later he renamed *M. maduei.* In 1931 the writer described a third new species under the name of *M. cobbi.* In connection with renaming this species further studies have recently been made and its close similarity to *M. parvus* discovered. It is now thought best to retain it as a new variety of *M. parvus.* The head is provided with an inner circle of 6 papillae striated on the lips, and an outer circle of 10 papillae.

Measurements:	3.0	9.0	26.0	64.0	92.0	1.2 mm.
	2.0		3.9	4.0	2.6	

The lips exhibit 6 papillae situated in an inner circlet of 6 and an outer circlet of 10. The dorsal and ventral lip each have an additional single nerve fibre situated mediad to the central papilla and simulating a papilla in its formation. The stirrup-shaped amphid is large and easily seen. Just posterior to the

nerve ring, which is situated at 9 per cent of the body length, is a faintly discernible vestigial excretory pore. The ovarian tubes are paired and reflexed, the anterior to the left, the posterior to the right of the intestine. Occasionally, however, a specimen is observed in which this arrangement is reversed. The oval eggs were found to correspond to those of *M. parvus* (100 μ). The conical tail is devoid of a spinneret and is provided with a pair of dorso-submedial papillae situated at the beginning of the middle third, and a second pair of ventro-submedial papillae at the beginning of the last third of the tail (Fig. 1). The intestinal contents frequently include disintegrating portions of nematodes and rotifers. Specimens of this species were found at Haleakala, Maui, Hawaii, in soil around dandelion roots growing at an elevation of 8,000 to 9,000 feet at Kona, Hawaii, and in soil surrounding coffee roots at an elevation of 2,000 feet.

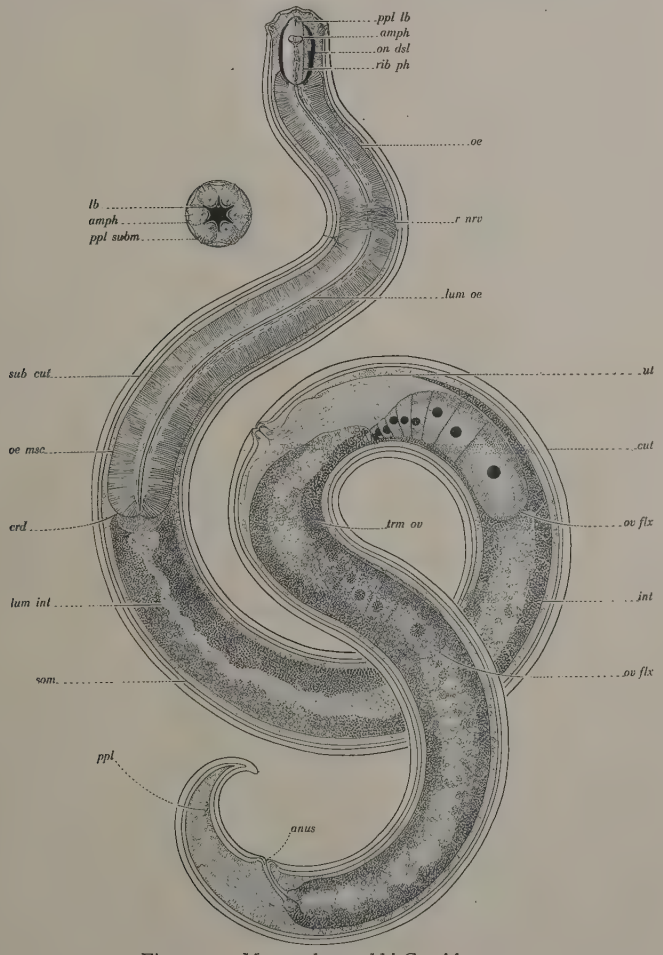

Figure 1. *Mononchus cobbi* Cassidy, 1931

5. Changes in the generic position of certain nematode parasites of fishes formerly placed in the genus FILARIA. B. G. CHITWOOD.

The following species of nematode parasites of fishes have been incorrectly placed in the genus *Filaria* and are herein transferred to the genera in which the writer believes they should be placed: *Filaria bicolor* Linstow, 1873 (syn. *Spiroptera bicolor* (Linstow, 1873) Linstow, 1899) not *Filaria bicolor* Creplin, 1825, appears from the character of the esophagus and the cephalic papillae to be a member of the genus *Eustrongylides*; for this species the name *Eustrongylides linstowi* new name is proposed. *Filaria conoura* Linstow, 1885 (syn. *Spiroptera conoura* (Linstow, 1885) Linstow, 1909, and *Filaria hellichi* Sramek, 1901, appear to belong to the genus *Rhabdochona,* the proper names are, therefore, *Rhabdochona conoura* (Linstow, 1885) n. comb. and *Rhabdochona hellichi* (Sramek, 1901) n. comb. *Filaria galeata* Linton, 1905, appears to be a member of the genus *Cystidicola,* the correct name being *Cystidicola galeata* (Linton, 1905). *Filaria ochracea* Linstow, 1894, is placed in the genus *Ascarophis,* the name being *Ascarophis galeata* (Linstow, 1894) n. comb.

6. The systematic position of ECHINONEMA GRAYI *Gemmill,* 1901. B. G. CHITWOOD.

Gemmill (1901) described a new genus and species of nematode from the sea urchin, *Echinus escul,* and called it *Echinonema grayi.* The name *Echinonema* had been previously used for another nematode, *Echinonema* Linstow, 1898, type *E. cincta* Linstow, 1898. Gemmill's species was redescribed and placed in the genus *Ichthyonema* (=*Philometra*) by Gemmill and Linstow, 1902, and subsequently transferred with other species of the genus *Ichthyonema* to *Philometra* by Yorke and Maplestone (1926). In the course of the preparation of a monograph on the Philometridae and the Dracunculidae, the writer has found no justification for retaining Gemmill's species in the genus *Philometra.* The character of the esophagus, which is not enlarged at the anterior end, and is degenerate and "tubular" posteriad, the presence of criss-cross fibers in the cuticle, and the morphology of the larva which is bluntly rounded at both extremities, are sufficient to exclude the species from either the Dracunculidae or the Philometridae. The species in question presents some similarities to the Mermithidae, namely, the character of the esophagus and the cuticle. However, the intestine is not degenerate as in the Mermithidae, and a stylet has not been described; the latter is a character of the Mermithidae. The writer proposes a new genus *Echinomermella* with *E. grayi* (Gemmill, 1901) as type species, synonyms—*Echinonema* Gemmill, 1901, not Linstow, 1898; *Ichthyonema grayi* (Gemmill, 1901) Gemmill and Linstow, 1902; and *Philometra grayi* (Gemmill, 1901) Yorke and Maplestone, 1926, for this species. In the absence of pertinent information the genus *Echinomermella* is appended to the Mermithoidea.

7. Observations on the length of dormancy in certain nematodes infesting plants. MARGARET N. CORDER.

Samples of nematode-infested plant material were placed in boxes, at the Salt Lake Station of the Division of Nematology, Bureau of Plant Industry, U. S. Department of Agriculture, and kept at room temperature to determine how long the nematodes could remain dormant and be revived. The following table gives these data, as now available. Sample number 16, collected in 1924, was examined on November 8, 1929, and the greater portion of the specimens were then alive and normally active, but, as may be seen from the table, in 1933 none of the nemas were alive. Sample number 2, collected in 1925, was also examined in November, 1929, very few nematodes being alive at this time. In 1933 all the nemas were dead. Practically all nematodes remaining alive were in the preadult stage and a large number of these contained conspicuous glossy bodies. All samples (see Table 1), which in the 1933 examination contained living nematodes, were kept for future examination.

TABLE I.—*Showing results of examination of dormancy samples, April, 1933*

Sample Number	Species	Host	Date collected	Locality	Years - Dormant	Per cent. of worms alive
1	*Tylenchus dipsaci*	Alfalfa	November, 1924	Humbolt Co., California	9	0
2	" "	Alfalfa	September, 1925	West Jordan, Utah	8	0
3	" "	Teasle leaves	December, 1926	Santa Clara Co., California	7	6
4	" "	Garlic	1926	San Benito Co., California	7	20
5	" "	Long Leaf Plantation	May, 1927	Santa Cruz Co., California	6	60
6	" "	Teasle	June, 1927	Molalla, Oregon	6	100
7	" "	Oats	July, 1928	Santa Cruz Co., California	5	100
8	" "	*Hypochaeris radicata*	1929	Corvallis, Oregon	4	13
9	" "	*Crepis virens*	June, 1929	Salem, Oregon	4	0
10	" "	*Hypochaeris radicata*	June, 1929	Salem, Oregon	4	5
11	" "	Alfalfa seeds	September, 1929	Gusher, Utah	4	5
12	" "	Alfalfa	October, 1929	West Jordan, Utah	4	0
13	*Tylenchus pratensis*	Fig roots	April, 1929	Merced, Califoria	4	0
14	*Tylenchus tritici*	Wheat	1922	Madison, Wisconsin	11	100
15	*T. balsamophilus*	*Wyethia amplexicaulis*	May, 1923	Wellsville, Utah	10	0
16	*T. balsamophilus*	*Balsamorrhiza sagitatta*	July, 1924	Wellsville, Divide, Utah	9	0
17	*T. balsamophilus*	*Balsamorrhiza sagitatta*	August, 1925	Wellsville, Utah	8	100

8. Preliminary observations on the life history and morphology of TYLOCEPHALUS BACILLIVORUS *n. g., n. sp., a nematode related to the genus* WILSONEMA. LOUISE CROSSMAN.

Through the courtesy of Dr. Charles Drechsler, of the Bureau of Plant Industry, U. S. Department of Agriculture, the Division of Nematology received some specimens of a nematode, originally found in leaf mold at Clarendon, Virginia, which appear to constitute a new genus and species. These nematodes resemble *Chambersiella,* some species of *Acrobeles* and *Wilsonema,* in the possession of highly complicated cephalic appendages. However, while the first 2 genera mentioned are more closely related to *Cephalobus, Wilsonema* and the new forms are closer to the genus *Plectus.* Since the new forms do not appear to belong to any existing genus, a new genus, *Tylocephalus,* is proposed, type species: *T. bacillivorus,* n. sp. As stated above these nemas are characterized by the possession of peculiar, elaborate cephalic appendages. As has been found to be the case in nematodes possessing this type of cephalic structure the appendages appear while the nemas are still in the larval stage of development. The newly hatched specimens of *T. bacillivorus* closely resemble *Plectus* in having on the head six papillae of the inner and four larger setose papillae of the outer circle, which may have a functional relationship to the mode of feeding. Very little is known about the food habits of soil inhabiting nematodes. *T. bacillivorus* feeds on bacteria and apparently prefers and possibly requires a particular kind. In all the specimens examined, bacteria of the bacillate group have been found in the intestines. When individuals of this species are kept in cultures which are free from bacteria of this kind the nemas move very rapidly over the surface of the medium as though seeking food. However, when a small globule of bacilli is introduced into the center of the dish the nemas proceed from all directions toward the bacteria. After reaching the group of bacteria the nemas begin feeding and remain constantly near the group of bacteria, which indicates that *T. bacillivorus* has a highly developed and specialized food sense. In studying the development of this form an egg was mounted in a small globule of agar taken from a bacteria inoculated culture. A cover glass was placed over this and sealed with wax. The preparation was kept in a moist chamber when not under observation. The egg hatched and the larva grew to an adult female within seven days. This female nema deposited 33 eggs over a period of 10 days. The first 4 of these eggs developed and hatched, as did the sixth, the ninth, the tenth, the twenty-eighth, the twenty-ninth, and the thirty-first eggs, the incubation period averaging about 27 days. The development of a second generation from a female reared from an isolated egg demonstrates that this species is either hermaphroditic or parthenogenetic.

Tylocephalus n. g.

Generic diagnosis: Plectinae: Resembling the genus *Wilsonema* Cobb, 1913, but with the following differences: Head bearing four stout, tapering, incurved, non-branched, seta-like projections, two dorso-submedian and two ventro-submedian, the bases of which are thickened and set off. Type species: *T. bacillivorus* n. sp.

Tylocephalus bacillivorus n. sp.

Specific diagnosis: $\frac{4.7 \quad 14.3 \quad 24.0 \quad 50.0 \quad 92.5}{2.8 \quad 4.9 \quad 5.8 \quad 7.3 \quad 3.2}$ .546 mm.

Generic characters. Cuticle with moderately conspicuous transverse striae. Dorsal and ventral cephalic cushions conspicuously elevated, transversely striated, and extending posteriad a distance of 14 μ, each supported by a transparent central rib which extends the entire length of the cushions. Two membranes, one dorsal and one ventral, continuations of the cuticle surrounding the cephalic cushions, extend between the seta-like projections and are each supported internally by a hand-like process arising from a point about midway between the mouth opening and the bases of the seta-like projections. Laterally there is a

low innervated papillate projection. Amphids modified spirals of one turn, 8 μ from anterior extremity. Pharynx subcylindrical, extending to level of posterior margin of cushions. Spinneret and caudal glands present. Vulva near middle of body, reproductive system double, ovaries reflexed. Male not known. Habitat: Leaf Mold, Clarendon, Virginia.

A more detailed description with figures is to be published later.

9. ANTILOCAPRA AMERICANA *an additional host of* NEMATODIRELLA LONGISPICULATA. G. DIKMANS.

Some nematodes collected from the small intestine of a mule deer, *Odocoileus hemionus,* by Mr. W. M. Rush, at Yellowstone National Park, and recently submitted for examination, were found to belong in the genus *Nematodirus.* Thinking that these nematodes might be *Nematodirus antilocaprae* Price, 1927, the type specimens of this nematode were examined. This examination showed that the nematodes described under the name of *Nematodirus antilocaprae* belong in the genus *Nematodirella,* as at present defined. *Nematodirus antilocapra* therefore becomes a synonym of *Nematodirella longispiculata* and the antelope, *Antilocapra americana,* is added to the list of hosts of the nematode.

10. *A note on the life history of* OSTERTAGIA CIRCUMCINCTA. G. DIKMANS *and* J. S. ANDREWS.

A short time ago we expressed a doubt as to the correctness of the statement found in the literature that members of the nematode genus *Ostertagia* occur as adults in nodules in the fourth stomach of ruminants. We stated that it had been our experience that we found these adults usually in the pyloric end of the fourth stomach covered by a layer of mucus. A short time ago in connection with another experiment we had occasion to examine the stomachs of some sheep raised in our cages at Beltsville and placed on one of the pastures of the Animal Husbandry Division for a period of about 3 weeks. On post-mortem examination we observed numerous small, white, raised areas scattered through the stomach. Examination of these areas showed the presence of larvae of *Ostertagia.* In the pyloric end of the stomach we found numerous dark colored spots immediately beneath the mucosa. These spots contained nearly mature specimens of *Ostertagia circumcincta.* Other specimens of this nematode were found partly free in the cavity of the stomach and partly attached to the wall of the organ, still others were found free in the stomach. Our interpretation of the above findings is as follows: the third stage or infective larvae, after ingestion, penetrate the wall of the stomach and there undergo their metamorphosis to the adult stage. The adults emerge from the wall of the stomach into the cavity of the organ and live there covered by a layer of mucus.

11. *A note on the time of survival of larvae of* HAEMONCHUS CONTORTUS, OSTERTAGIA CIRCUMCINCTA, *and* NEMATODIRUS SPATHIGER, *on pastures.* G. DIKMANS *and* J. S. ANDREWS.

In connection with our note on the life history of *Ostertagia circumcincta* we would like to call attention to the fact that these same sheep showed infestations with *Haemonchus contortus* and *Nematodirus spathiger* as well as with *Ostertagia circumcincta.* Since the pasture on which these animals were grazed had been vacant since last fall and our sheep, raised in cages at Beltsville, showed no nematode infestation as determined by fecal examination, previous to their being placed on this pasture, this shows that whatever infection was present on this pasture last fall survived over the winter.

12. *New snail hosts for* FASCIOLA MAGNA (BASSI, 1875) STILES, 1894. WENDELL H. KRULL.

The snails, *Fossaria modicella rustica* (Lea) and *Pseudosuccinea columella* (Say), identified by Mr. Wm. B. Marshall, of the National Museum, are reported

to be new intermediate hosts of *Fasciola magna*. The infections were obtained experimentally in snails raised from eggs and infected in the laboratory. The original stock of *F. modicella rustica* was secured from Utah, May, 1932, and the original stock of *P. columella* was collected locally in May, 1932, and subsequently several generations of both species have been raised in the laboratory. The laboratory raised snails were subjected to infection of miracidia at a temperature of 85° F. and subsequently kept at a temperature of between 80° F. and 85° F.; *F. modicella rustica* under these conditions shed the first cercariae in 40 days and *P. columella* in 49 days. The eggs of *F. magna* used in the tests as well as the specimens from which the eggs were taken were collected from *Bos taurus* by Dr. C. H. Horcher in Houston, Texas.

13. The snails, Pseudosuccinea columella *and* Galba bulimoides techella, *new hosts for* Paramphistomum cervi (*Schrank,* 1790) *Fischder.,* 1901. Wendell H. Krull.

Pseudosuccinea columella, identified by Mr. Wm. B. Marshall, of the National Museum, has been found to be a new host for *Paramphistomum cervi.* The infections were obtained experimentally in snails raised from eggs and infected in the laboratory; the original stock was collected locally, May, 1932. The laboratory raised snails used in the infection experiments were subjected to miracidia at a temperature of 80° F. to 85° F. The snails under these conditions shed the first cercariae in large numbers in 43 days. The infected snails could easily be distinguished by naked eye examination because the cercariae were highly pigmented and because they were distributed throughout the snail's tissues; the snail's shell is transparent and light in color so that the cercariae in the tissues made the infected snails appear to be very dark in color as if exhibiting melanism. The eggs of *P. cervi* used in the experiments as well as the specimens from which the eggs were taken were collected from *Bos taurus* by Dr. H. Marshall near Richmond, Virginia.

Snails, *Galba bulimoides techella,* infected with *P. cervi* were collected in a pasture in Alabama, May 12, 1933, five of 120 snails being infected. Identification of the snails was made by Mr. Wm. B. Marshall, of the National Museum.

14. Notes on Clinostomum. Wendell H. Krull.

In view of the paper recently published by Hopkins (1933) the following notes concerning data on development, length of life and fate of the metacercaria of *Clinostomum* should be reported. Tadpoles of *Rana pipiens,* ready to transform, were collected in Douglas Lake, Michigan, July 29, 1929, and in the fall of 1929, after they had transformed, the frogs were taken to Ann Arbor, Michigan, and kept in a cool aquarium room. Typical metacercariae of *Clinostomum,* which had reached about ⅔ of the maximum size, were recovered when these frogs were examined November 16, 1929. This seems to indicate that several months may be necessary for the development of the metacercaria. A large *R. pipiens* was caught on the shore of Burt Lake, Michigan, June 19, 1928, and kept under controlled conditions until it was examined December 11, 1929, at which time a single *Clinostomum* was recovered from the lower jaw muscles, consequently, the metacercariae may live more than 17 months in a frog. A small green frog, *R. clamitans,* collected near Ann Arbor, Michigan, April 18, 1931, showed *Clinostomum* cysts in the process of disintegration and the frog was kept under observation for several days. Each cyst undergoing degeneration was red due to the serous fluid which it contained. In cysts just under the skin the metacercariae could be observed in these bloody cysts. The cysts in such a location would usually rupture during the night, discharge the contents into the surrounding tissues, and clear up quickly while the metacercariae were observed in some cases to wander in the lymph spaces for a varying length of time before disintegrating. In several cases, disintegrating cysts in the skin which were only held by epidermis would rupture and discharge the contents to the exterior and be completely closed up the following morning.

–15. *Notes on* ALLASSOSTOMA PARVUM *Stunkard.* WENDELL H. KRULL.

Helisoma antrosa (Conrad) has been found to be a new host for *Allassostoma parvum.* Eight of 289 snails, *H. antrosa,* collected in two ponds near Beltsville, Maryland, were infected. The snapping turtle, *Chelydra serpentina,* is the definitive host in this region. Beaver (1929) states that he infected *Rana catesbeiana* and found this frog and *R. pipiens* naturally infected. The writer has attempted to infect numerous *R. catesbeiana* and *R. clamitans* experimentally with negative results and no natural infections have been observed in frogs of the two above-mentioned species collected in the ponds in which the infected snails occur. In the attempts to infect frogs experimentally, it was observed that the immature flukes could be recovered in the rectum of the frogs only if they were examined in 1 or 2 days after the cysts were administered. Beaver found that the cercariae of *A. parvum* encysted on crayfish, *Cambarus* (*Faxonius*) *propinquus,* and frogs, *R. pipiens,* and states that he obtained his experimental infections by feeding these to the definitive hosts. That this is possibly not the only way that infections may be obtained is shown by the following observations. A large snapping turtle was observed in the act of gorging itself with partially decayed pond lilies, genus *Nymphaea.* The turtle was subsequently captured and the digestive system was found to be completely filled with pond lily material in various stages of digestion. Since the cercariae of *A. parvum* encyst readily on pond lilies, as observed in the laboratory, the turtles may become infected by eating these plants. A series of 20 cysts of *A. parvum* varied in diameter from 420 μ to 460 μ (average 440 μ). Encysted metacercariae have been kept alive in clean water under laboratory conditions for 2 months. The cysts are very resistant to a saturated solution of corrosive sublimate to which acetic acid is added, movements of the imprisoned metacercariae having been observed 3½ hours after the cysts were placed in the solution.

16. A note on the toxic effect of copper for snails. WENDELL H. KRULL.

Laboratory experiments with metallic copper and copper carbonate show that they are lethal to snails even when the snails are exposed to small amounts of the metal (precipitated powder) or carbonate in large quantities of water, the maximum of 10 days being required to kill *Pseudosuccinea columella* exposed to 10 milligrams of either the copper or the carbonate in 18 liters of water. The majority of the snails are killed in 4 or 5 days but usually 3 or 4 of the 35 snails used as test samples exhibited more resistance or crawled out of the water for varying lengths of time thus increasing the time for lethal action as given above. The difference in resistance of snails of the same species also was observed by Chandler (1920) in his work on copper sulphate. Controls were used in the tests. The various forms of copper were used in both alkaline and acid water with and without decaying organic matter and in all cases the snails have been killed. The greater part of the work to date has been done with the snail *P. columella,* immature and mature specimens having been used. Preliminary experiments with the snails, *Fossaria modicella, Stagnicola coperata, Lymnaea palustris,* and *Helisoma trivolvis,* show that they are likewise affected but that the time required for lethal action may vary somewhat with the particular species. As a result of these experiments copper ores, secured from the U. S. National Museum, are being tested on the snail, *P. columella,* and to date the following ores, copper impregnated conglomerate, argentiferous azurite cerussite and silica carbonate of copper have been found to be lethal in preliminary experiments in which 100 milligrams of pulverized ore was used in 2 liters of water. It is hoped that succeeding experiments both in the laboratory and in the field may result in the finding of a more practical and cheaper means of exterminating snails in fluke control work than those used at the present time.

17. Studies on the life history of BRACHYLAEMUS *sp. possibly* B. SPINOSULUM (*Hofmann,* 1899). WENDELL H. KRULL.

The life history of *Brachylaemus* sp. possibly *Brachylaemus spinosulum* has been completed under laboratory conditions using the snail, *Polygyra thyroides,*

as the intermediate host and the opossum, *Didelphis virginiana virginiana,* for the definitive host. The snails were raised from eggs in small terraria on dirt which was sterilized and the parent snails were removed before the eggs hatched. The opossums were taken with the mother when they were about the size of house mice and raised under controlled conditions. Two types of infected snails occur; those with sporocysts and those without sporocysts. These types of infection exist because the cercariae produced by the sporocysts may be transferred from one snail to another by contact, the cercariae so transferred begin to develop into metacercariae in 21 days, the beginning of the metacercaria existence being based on the loss of the cercarial tail. Snails which harbor an active infection (meaning snails with sporocysts from which cercariae are escaping) can be detected by examining the surface of the body of the snail, which is usually covered with active cercariae wandering in the slime. Eggs of this parasite were recovered in the feces of experimentally infected opossums on the 19th day after the metacercariae were administered. The species here discussed appears to fit more closely the description of *B. spinosulum* Hofmann than that of any of the other species of the genus. Since the parasite occurring in the local opossum has been called by several names, apparently because of the variation in individual specimens it may be noted that my identification is based on a series of 47-day-old specimens, 222 of which were taken from an experimental animal which had been infected with metacercariae from a laboratory raised and infected snail. The very decided uniformity in the anatomy of the series of adult specimens was striking and it is strongly suspected that more than one species occurs in the region. This conclusion is in the process of verification. (Details of the life history to be published elsewhere.)

18. Equine parasites from Puerto Rico. Allen McIntosh.

Two shipments of nematodes collected from horses and mules were recently forwarded to the Bureau of Animal Industry by Dr. H. L. van Volkenberg, of the Puerto Rico Agricultural Experiment station for identification. Some of the parasites were collected after they had been passed by the host, following treatment with carbon tetrachloride, and were, therefore, not in the best condition for identification.

The following species have been identified: *Probstmayria vivipara, Oxyuris equi, Habronema megastoma, Habronema microstoma, Trichostrongylus axei, Strongylus equinus, Strongylus edentatus, Strongylus vulgaris, Craterostomum mucronatum, Oesophagodontus robustus, Gyalocephalus capitatus, Triodontophorus brevicauda, Triodontophorus tenuicollis, Triodontophorus intermedius, Poteriostomum imparidentatum, Poteriostomum ratzii* var. *nanum, Cylicocyclus insigne, Cylicocyclus radiatus, Cylicocyclus nassatus, Cylicocyclus nassatus* var. *parvus, Cylicocyclus ashworthi, Cylicocyclus auriculatus, Cylicodontophorus ultrajectinus, Cylicodontophorus bicoronatus, Cylicodontophorus ihlei, Cylicodontophorus euproctus, Cylicocercus goldi, Cylicocercus catinatus* var. *pseudocatinatus, Cylicostephanus calicatus, Cylicostephanus minutus, Cylicostephanus longibursatus, Cyathostomum coronatum, Cyathostomum ornatum, Cyathostomum labratum, Cyathostomum labiatum, Cyathostomum labiatum* var. *digitatum, Cylicotetrapedon bidentatum.*

19. What is Ascocotyle plana *Linton?* E. W. Price.

In 1928 Linton described as *Ascocotyle plana* a trematode from a green heron, *Butorides virescens,* which Witenberg (1928) regarded as a synonym of *Pygidiopsis genata* Looss, and which Travassos (1930) regarded as a synonym of *Ascocotyle* (*Phagicola*) *angrense* (Travassos). In view of this difference of opinion the writer has examined the type specimens in order to settle the question. The specimens, two in number (one incomplete), were found to have been reasonably well described by Linton; he failed, however, to state whether or not a posterior prolongation of the oral sucker was present; and an error was made as regards the length of the ceca. The oral sucker was found to be of the con-

ventional type for heterophyids other than those belonging in the genera *Ascocotyle* and *Phagicola,* and the intestinal ceca were longer than shown in the illustration given by Linton. The absence of the posterior prolongation of the oral sucker, frequently referred to as an "appendix," and the general body organization makes it necessary to refer *A. plana* to the genus *Pygidiopsis.* No oral coronet such as described by Witenberg for *Pygidiopsis* was found although it is possible that the spines might have dropped off before fixation. Despite the fact that *A. plana* Linton belongs to the genus *Pygidiopsis* it cannot be regarded as being the same as *P. genata,* which is the opinion of Witenberg, until more information is available as regards Looss' *P. genata.* Witenberg stated that the eggs of the specimens described by him as *P. genata* were provided with a "conspicuous filament on the posterior pole," a character not mentioned by Looss. However, if the species described by Witenberg is the same as that described by Looss, *P. plana* (Linton) must be regarded as a distinct species, since the eggs of the latter species are not provided with filaments.

20. *New host records for trematodes of the genus* PHAGICOLA. E. W. PRICE.

While making a study of the heterophyids in the helminthological collection of the U. S. National Museum, specimens of two species belonging to the genus *Phagicola* were encountered, which had been collected from animals not previously reported as hosts for these parasites. The first of these species is *Phagicola nana* (Ransom), originally reported from an Alaskan fox (*Vulpes lagopus*). Several specimens of this species were found which had been collected from a booby, *Sula bassana,* in 1893 by Dr. Albert Hassall. The outstanding character of this species is the arrangement of the spines of the oral coronet, there being a complete anterior row of 16 spines and an incomplete posterio-dorsal row of 3 to 4 spines. The second is *Phagicola longa,* a species originally described by Ransom from an Alaskan fox (*Vulpes lagopus*) and subsequently reported by Witenberg from the dog, cat, and Persian wolf. Three specimens of this form were collected by the writer, March 15, 1927, from the small intestine of a pelican (species not determined) which died in the National Zoological Park. These specimens corresponded closely with the description of this species as given by Witenberg but differed from that given by Ransom in certain respects. An examination of Ransom's types revealed that most of the specimens were anomalous and that the figure given in Ransom's paper represented one of these anomalous specimens, since it shows only two vitelline follicles on each side, the normal number being 5 or more. The greatest number of anomalies in the type specimens were in connection with the vitellaria. Two of the specimens showed unilateral vitellaria; one specimen showed marked asymmetry of these glands, and minor variations of the vitellaria were noted in other specimens. One specimen lacked a functional ovary, this organ being represented by a small clear vesicle; as might be expected in such a case, no eggs were present. One specimen showed, in addition to other anomalies, an atrophic right testis but its function apparently was not entirely destroyed.

21. *A note on the genus* SCHISTOSOMA *Weinland.* E. W. PRICE.

In a review of Senn's "Theodor Bilharz. Ein deutsches Forscherleben in Aegypten 1825–1862," Prof. R. T. Leiper has pointed out that the generic name *Bilharzia* Cobbold, 1859, is antedated by *Bilharzia* Meckel von Hempsbach, 1856. In commenting on this matter of priority Prof. Leiper stated: "Those who regretted the displacement of the generic name *Bilharzia* Cobbold, 1859, by *Schistosoma* Weinland, 1858, under the Law of Priority will rejoice in the restoration of *Bilharzia* Meckel, 1856, under the same Law." The present writer has not had access to the literature bearing on this matter, but in this case priority is of little moment in view of the fact that in 1922 *Schistosoma* was placed on the list of official names under Opinion 77 of the International Commission on Zoological Nomenclature. Recently, P. L. LeRoux has reverted to the use of the generic name *Bilharzia* and has described a new blood fluke of ruminants as *Bilharzia*

margrebowiei, and has placed the other species of the genus *Schistosoma* in the genus *Bilharzia.* Under Opinion 77 just referred to, *B. margrebowiei* LeRoux becomes *Schistosoma margrebowiei* (LeRoux).

22. On the number of TYLENCHUS DIPSACI *present in a narcissus leaf typically infested by this parasite.* GRACE W. SHERMAN.

In the study of the development of the *Tylenchus dipsaci* disease in narcissus bulbs, the question arose as to the number of nematodes, the ratio of their various developmental stages (eggs, larvae, preadults, adults), and their sexual ratio in a typically infested plant. As no information of this kind was available, such an estimate was made in the following manner: A typically infested leaf of a King Alfred plant was selected and a section 6×22 mm. in size cut out, shredded and soaked in water. The total number of nematodes soaked out of this section was determined by means of a marked watchglass and the usual counting methods, and found to be 7,660. Of this 7,660 total, 1,157 (15 per cent) were females; 1,207 (16 per cent) were males; 1,636 (21 per cent) were preadults; 1,725 (23 per cent) were young larvae, and 1,935 (25 per cent) were eggs. The sexual number was also calculated and found to be 108. That is, to every 100 females there were 108 males in this particular infestation. The sexual number varies in different infestations. I have found it to be all the way from 112 to 65, the average being about 83. If this narcissus leaf were uniformly infested, it would contain approximately 304,800 *T. dipsaci.* Since the various leaves on the same plant are not usually uniformly infested, and since the bulb as well as the leaves contain this parasite, it would be very difficult to estimate accurately the number of nematodes in the entire plant, but the figure most certainly runs into the milllions.

23. The occurrence of DIROFILARIA IMMITIS, *and the incidence of intestinal helminths in Virginia dogs.* PAUL C. UNDERWOOD.

Larvae of the heartworm, *Dirofilaria immitis,* were found in the peripheral blood of 1 of 20 dogs obtained from the Alexandria, Virginia, dog pound. A second animal was observed, on post-mortem examination, to be infected with *D. immitis,* a single male specimen of this parasite being found in the heart.

The incidence of infection of these 20 animals with intestinal helminths, as determined by post-mortem examinations, is shown below.

Parasite	Per cent. of 20 dogs infected
Ascaris (both species)	10
Ancylostoma caninum	35
Trichuris vulpis	60
Taenia pisiformis	10
Dipylidium caninum	35

Of the 20 dogs examined, post-mortem, 10 per cent. were found to be free of all intestinal helminths.

24. A critical experiment with Santonin in small single doses for intestinal helminths of dogs. PAUL C. UNDERWOOD.

In order to determine the efficiency of small single doses of Santonin in ridding dogs of intestinal helminths, 6 puppies from the same litter (6 weeks of age) were fasted 18 hours, at the end of which time they were treated with Santonin as shown below. Three of the puppies, weighing from 2.03 to 2.72 kilograms were each given 1 grain of Santonin crystals. The other 3 puppies weighing from 1.47 to 1.91 kilograms were each given ½ grain of Santonin crystals In each case, the drug, in a hard gelatin capsule, was administered by mouth. One hour after treatment the animals were fed. All the feces passed by each animal for 3 consecutive days after treatment were examined for the presence of worms that had been expelled by the Santonin. At the end of this three-day period a post-mortem examination for intestinal helminths was made of each

puppy. On the basis of the number of worms recovered from the feces of the puppies after treatment and the number of worms recovered from the intestine of each animal, post-mortem, the average per cent. of the various species of worm parasites removed from the infected animals by the treatment, was calculated. The results are listed below.

Per cent. of worm parasites removed from infected animals by 1 grain of Santonin—

Toxascarids	0 per cent.
Hookworms	0.4 per cent.
Whipworms	0 per cent.

Per cent. of worm parasites removed from infected animals by ½ grain of Santonin—

Toxascarids	0. per cent.
Hookworms	1.9 per cent.

In the case of most of the puppies, the parasitic infections were quite heavy so that the almost negligible number of worms removed by the treatment indicates that Sanotin crystals in small single doses have a very low rating of efficiency in removing worms from dogs.

25. Observations on the periodicity of Dirofilaria immitis *larvae in the peripheral blood of dogs.* Paul C. Underwood *and* Willard H. Wright.

The observations reported here extended over a period of 24 consecutive hours and consisted of making counts, at 2 hour intervals, of the number of microfilaria present in measured quantities of the peripheral blood of 2 dogs infected with *Dirofilaria immitis*. In making the examinations, 0.01 cc. of blood was withdrawn from the right ear vein of each dog. Each sample of blood was then mixed with an equal amount of 2 per cent. sodium citrate on a clean glass slide and covered with an inch square cover glass. A count was then made, under low power magnification of the microscope, of the number of microfilaria in the blood and citrate mixture. The first samples were taken at 8 P. M., December 10, 1932. Following this, additional samples were taken and counts made at 2 hour intervals until 6 P. M., December 11, 1932. Microfilaria were present in each of the 24 blood samples taken from the 2 dogs. In making these examinations it was observed that the number of microfilaria in the blood samples began to increase at 6 P. M. From that time on there was a gradual, although somewhat irregular, increase in the number of larvae in the blood samples, until 2 A. M. when an evident peak was reached. After 2 A. M. the number of microfilaria in the blood samples gradually declined.

26. Echinuria spinosa *Maplestone,* 1931, *a male of the genus* Tetrameres. E. E. Wehr.

In a note presented before this Society, on March 18, 1933, the writer called attention to certain structures present on the males of *Tetrameres fissispina,* and perhaps on other species of this genus, which have been misinterpreted as "cordons." It was then pointed out that as a result of this misinterpretation certain nematodes have been erroneously classified as belonging to a new genus and species. At this time the writer calls attention to an error in the interpretation of these structures which led to the creation, by Maplestone, of a new species, "*spinosa*" in the genus "*Echinuria,*" to accommodate certain parasitic nematodes of which only males were found. In commenting on the possible correct systematic position of this species, Maplestone says, "Apart from the cordons, this worm closely resembles certain males of the genus *Tetrameres,* especially with regard to the short stout vestibule. The absence of females also suggests that it may possibly belong to this genus, but no species of *Tetrameres* have cordons, therefore in the absence of the characteristic females it is considered advisable to place it in the genus Echinuria." In his previous note, the writer stated that

these structures, erroneously called cordons by Thwaite (1926), and more recently by Maplestone (1931), are not cordons, but the dorsal and ventral cuticular projections of the lateral alae. The accompanying figure represents a cross section of *Tetrameres fissispina* in the region of the so-called cordons. By showing that these cordons actually are outgrowths from the lateral alae, the writer hopes that misinterpretations of these structures will be avoided in the future.

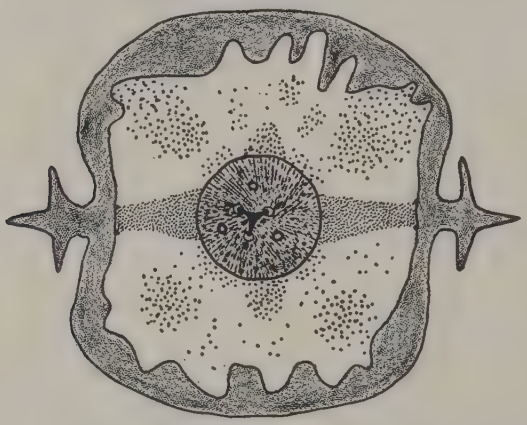

Figure 2. Cross section through body of a male specimen of *Tetrameres fissispina* showing outgrowths from the lateral alae which have been mistaken for cordons. ×875.

27. The anthelmintic efficacy of primary monobrom hydrocarbons for Ancylostoma caninum. W. H. Wright *and* J. M. Schaffer.

Critical tests with 5 compounds in this series gave the following results:

Compound	Anthelmintic Efficacy	Water Solubility
	per cent.	
N-Propyl Bromide	58.1	1:400
N-Butyl Bromide	99.2	1:1600
N-Amyl Bromide	84.3	1:6000
N-Hexyl Bromide	53.8	1:12000
N-Heptyl Bromide	33.0	1:30000

In our study of chlorinated alkyl hydrocarbons (Am. J. Hyg., v. 16, No. 2), it was found that the anthelmintic efficacy of primary monochlor compounds reached a peak within the series and then declined. The opinion was expressed that in a similar way other homologous series would each have a peak of anthelmintic efficacy by reason of the fact that a point would be reached where the solubility of a higher member would be so slight as to result in little or no anthelmintic efficacy. The results secured with the present series parallel those obtained with primary monochlor hydrocarbons and further bear out this opinion. In each of the two series, the peak of anthelmintic efficacy was reached with the butyl member. N-Butyl bromide is the only member of this series having a water solubility which falls within the optimum solubility range (1:1250 to 1:5300) for chlorinated hydrocarbons, *i.e.*, the range in which the greatest anthelmintic efficacy was secured. This fact further emphasizes the important relationship existing between anthelmintic efficacy for hookworms and water solubility of halogenated hydrocarbons.

PROGRAM AND ABSTRACTS OF THE NINTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS

BOSTON, MASSACHUSETTS

DECEMBER 28, 29 and 30, 1933

PROGRAM[1]

THURSDAY MORNING SESSION, DECEMBER 28, 10:00 A. M.; ROOM 202, PIERCE HALL, HARVARD UNIVERSITY.

Read

1. The Distribution of Flagellates in Termites of the Genus *Kalotermes* s. lat. (4 min.) (Lantern.) HAROLD KIRBY, University of California.

2. Comparative Morphology of the Devescovinid Flagellates of Termites. (11 min.) (Lantern.) HAROLD KIRBY, University of California.

3. The Structure of *Trichomonas vaginalis*. (10 min.) (Lantern.) THOMAS BYRD MAGATH, Mayo Clinic, Rochester, Minnesota.

4. On an Amoeba Parasitic in *Zelleriella* (Protozoa, Ciliata). (10 min.) (Lantern.) (Also by demonstration.) R. M. STABLER, University of Pennsylvania.

5. A New Species of *Nyctotherus* (Protozoa, Ciliata) from a Chinese Frog. (10 min.) (Lantern.) (Also by demonstration.) RALPH WICHTERMAN, University of Pennsylvania.

6. A Gregarine Parasitic in the Striped Shore Crab, *Pachygrapsus crassipes*. (12 min.) (Lantern.) GORDON H. BALL, University of California at Los Angeles.

7. Rediscovery of *Eimeria carinii* Pinto, 1928. (10 min.) (Lantern.) E. R. BECKER and R. D. BURROUGHS, Iowa State College.

8. Artificial Extension of the Intervals Between Oöcyst-Peaks in the Sparrow Coccidium. (12 min.) (Lantern.) DONALD C. BOUGHTON, FLOYD O. ATCHLEY, and LYDIA C. ESKRIDGE, Harvard University and Johns Hopkins University.

9. Some Physiological Effects of Coccidia on Chickens. (7 min.) (Lantern.) C. A. HERRICK, University of Wisconsin.

10. Effect of Oily Mixtures of Phenolics on the Oöcysts of Poultry Coccidia, with Special Reference to *Eimeria tenella*. (15 min.) (Charts.) JUSTIN ANDREWS, Johns Hopkins University.

By Title

11. An Attempt to Transmit *Trichomonas vaginalis* to the Intestinal Tract of Kittens. JOHN F. KESSEL, University of Southern California.

12. The Duration of Malarial Infection in Birds. REGINALD D. MANWELL, Syracuse University.

13. The Effect of Rauwolfine on the Avian Malarias. REGINALD D. MANWELL, Syracuse University.

14. Protozoan Parasites of the Orthoptera, with Special Reference to Those of Central and Southeastern Ohio. FRANK M. SEMANS, The Ohio State University.

15. Bovine Coccidia Carriers. LOUIS V. SKIDMORE, University of Nebraska.

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[1] An alphabetical author index will be found at the end of the program.

THURSDAY AFTERNOON SESSION, DECEMBER 28, 2:00 P. M.; ROOM 202, PIERCE HALL, HARVARD UNIVERSITY.

Read

16. When Are *Ascaris* Eggs Infective? (15 min.) NORMAN R. STOLL, Rockefeller Institute for Medical Research, Princeton, N. J.

17. Resistance of the Cat to *Ascaris infection.* (15 min.) (Lantern.) MERRITT P. SARLES, Rockefeller Institute for Medical Research, Princeton, N. J.

18. On the Comparative Resistance of Six Breeds of Chickens to the Nematode *Ascaridia lineata* (Schneider). (15 min.) (Lantern.) J. E. ACKERT, L. L. EISENBRANDT, B. GLADING and J. H. WILMOTH, Kansas State College.

19. Sex Differentiation in Preparasitic Larvae of *Hyostrongylus rubidus* and Development of Male and Female Reproductive Systems. (15 min.) (Lantern.) (Also by demonstration.) J. E. ALICATA, Bureau of Animal Industry, Washington, D. C.

20. Observations on *Trichostrongylus tenuis* Infestation in Domestic and Game Birds in the United States. (15 min.) ELOISE B. CRAM and EUGENIA CUVILLIER, Bureau of Animal Industry, Washington, D. C.

21. Reaction of Laboratory Rats to Graded Numbers of *Nippostrongylus* Larvae. (15 min.) (Lantern.) GEORGE L. GRAHAM, Johns Hopkins University.

22. A Preliminary Report on the *in vitro* Consumption of Oxygen by Parasitic Nematodes. (10 min.) PAUL D. HARDWOOD and HAROLD W. BROWN, Vanderbilt University.

23. Oxidation-Reduction Potential as a Possible Factor in the Growth of Intestinal Parasites *in vitro.* (10 min.) (Lantern.) THEO. L. JAHN, Yale University.

By Title

24. On the Comparative Resistance of Bronze Turkeys and White Leghorn Chickens to the Nematode *Ascaridia lineata* (Schneider). J. E. ACKERT and L. L. EISENBRANDT, Kansas State College.

25. Control of Swine Kidney Worm. BENJAMIN SCHWARTZ, H. B. RAFFENSPERGER and LLOYD A. SPINDLER, Bureau of Animal Industry, Washington, D. C.

26. Wanderings of the Filariid Worm, *Icosiella quadrituberculata,* in the Bull Frog. JOHN GIESEN and J. L. WORDEN, College of St. Thomas.

27. The Characters of a Protonematode. B. C. CHITWOOD and M. B. CHITWOOD, Bureau of Animal Industry, Washington, D. C.

28. A Revised Classification of the Nematoda. B. G. CHITWOOD, Bureau of Animal Industry, Washington, D. C.

FRIDAY MORNING SESSION, DECEMBER 29, 10:00 A. M., ROOM 202, PIERCE HALL, HARVARD UNIVERSITY.

Read

29. Notes on the Economic Importance, Life History, and Control of *Moniezia expansa* Rudolphi, the Common Tapeworm of Sheep. (10 min.) STANLEY B. FREEBORN, University of California.

30. The Molluscan Phase of the Life Cycle of *Schistosoma mansoni.* (15 min.) (Lantern.) ERNEST CARROLL FAUST and WILLIAM A. HOFFMAN, Tulane University and Puerto Rico School of Tropical Medicine.

31. The Miracidium of *Clinostomum marginatum* (Rud.). (10 min.) (Charts.) (Also by demonstration.) WANDA SANBORN HUNTER and GEORGE W. HUNTER, III, Wesleyan University.

32. The Plerocercoid Larva of the Bass Tapeworm, *Proteocephalus ambloplitis* (Leidy), in the Small-Mouthed Black Bass. (10 min.) (Charts.) (Also by demonstration.) GEORGE W. HUNTER, III, and A. V. HUNNINEN, Wesleyan University and Johns Hopkins University.

33. *Diplostomulum* of *Triturus viridescens.* (7 min.) (Also by demonstration.) C. RUTH SHAW, University of Pittsburgh and Kent State College.

34. Some Host Parasite Relationships of Fish Parasites of the Trout Lake Region of Northern Wisconsin. (15 min.) S. X. Cross, University of Wisconsin.

35. An Apparent Case of a Pathogenic Rotifer (Order Bdelloida) in Man. (8 min.) John Giesen, College of St. Thomas.

36. Ova *Diphyllobothrium latum* in the Intestinal Contents of an Esquimo Mummy from Greenland. (10 min.) (Also by demonstration.) Thomas B. Pote, Washington University.

37. Observations on the Intestinal Protozoa of Young Pigs and Attempts to Produce Infection with a Human Strain of *E. histolytica.* (15 min.) (Lantern.) William W. Frye and Henry E. Meleney, Vanderbilt University and Tennessee State Department of Public Health.

By Title

38. Notes on the Life History of *Halipegus occidualis* (Stafford, 1905) in the green frog, *Rana clamitans.* Wendell H. Krull, Bureau of Animal Industry, Washington, D. C.

39. Notes on the Life History of a Frog Bladder Fluke. Wendell H. Krull, Bureau of Animal Industry, Washington, D. C.

40. *Plagitura parva* n. sp. from *Triturus viridescens.* Horace W. Stunkard, New York University.

41. The Life-Cycle of *Plagitura parva.* Horace W. Stunkard, New York University.

42. Life History of *Macroderoides typicus.* Donald B. McMullen, Monmouth College.

43. Resistance of Terns to Infestation with *Cryptocotyle lingua* (Creplin). Charles R. Willey, New York University.

44. The Susceptibility and Immunity of Certain Marine Fishes to *Epibdella melleni* MacCallum, a Monogenetic Trematode. Ross F. Nigrelli and C. M. Breder, Jr., New York Aquarium and New York University.

45. Some Trematodes of the Common Bullhead *Ameiurus nebulosus* (Le Sueur). John G. Arnold, Jr., New York University. (Introduced by Horace W. Stunkard).

46. *Sterrhurus* sp., a Hemiurid from the Gills of the Cutlass Fish (*Trichiurus lepturus* L.) Ross F. Nigrelli and Horace W. Stunkard, New York Aquarium and New York University.

47. Further Studies on Heterophyidae from Fish. Justus F. Mueller, New York State College of Forestry.

48. *Gyrodactylus* as a Parasite of the Tadpoles of *Rana catesbiana.* Horace W. Stunkard and F. W. Dunihue, New York University.

49. *Dicrocoelium lasiuri* n. sp. (Trematoda, Digenea) from the Liver of a Red Bat. Allen McIntosh, Bureau of Animal Industry, Washington, D. C.

50. *Naobranchia wilsoni,* a New Copepod from the Gills of *Diodon hystrix* L. Ross F. Nigrelli, New York Aquarium and New York University.

51. Warble Injuries to Reindeer Hides. W. E. Dove and E. C. Cushing, Bureau of Entomology, Savannah, Ga.

52. Migration of Warbles in Reindeer. W. E. Dove and E. C. Cushing, Bureau of Entomology, Savannah, Ga.

53. Further Studies on the Biology of the Pigeon Fly, *Pseudolynchia maura,* (Diptera, Hippoboscidae). Margaret Jo Prouty and G. Robert Coatney, Nebraska Wesleyan University and Peru State Teachers College.

Friday, Noon, December 29, 12:30 P. M., Faculty Club, Harvard University. Parasitologists' Luncheon.

All interested in parasitology are cordially invited.

The annual business meeting of the American Society of Parasitologists will be held following the luncheon.

FRIDAY AFTERNOON SESSION, DECEMBER 29, 3:00 P. M., ROOM E-290, BIOLOGICAL INSTITUTE, HARVARD UNIVERSITY.

By Demonstration

4. On an Amoeba Parasitic in *Zelleriella* (Protozoa, Ciliata). (Also read.) R. M. STABLER, University of Pennsylvania.

5. A New Species of *Nyctotherus* (Protozoa, Ciliata) from a Chinese Frog. (Also read.) RALPH WICHTERMAN, Unversity of Pennsylvania.

19. Sex Differentiation in Preparasitic Larvae of *Hyostrongylus rubidus* and Development of Male and Female Reproductive Systems. (Also read.) J. E. ALICATA, Bureau of Animal Industry, Washington, D. C.

31. The Miracidium of *Clinostomum marginatum* (Rud.) (Also read.) WANDA SANBORN HUNTER and GEORGE W. HUNTER, III, Wesleyan University.

32. The Plerocercoid Larva of the Bass Tapeworm, *Proteocephalus ambloplitis* (Leidy), in the Small-Mouthed Black Bass. (Also read.) GEORGE W. HUNTER, III, and A. V. HUNNINEN, Wesleyan University and Johns Hopkins University.

33. *Diplostomulum* of *Triturus viridescens*. (Also read.) C. RUTH SHAW, University of Pittsburgh and Kent State College.

36. Ova *Diphyllobothrium latum* in the Intestinal Contents of an Esquimo Mummy from Greenland. (Also read.) THOMAS B. POTE, Washington University.

54. Eleven Cases of Amoebiasis in Reptiles. HERBERT L. RATCLIFFE and QUENTIN M. GEIMAN, Zoological Society of Philadelphia and the University of Pennsylvania.

55. Effect of Quinine upon Reproduction of the Avian Malaria Parasite, *Plasmodium cathemerium*. GEORGE H. BOYD, University of Georgia.

56. *Sphyranura oligorchis* n. sp. from *Necturus maculosus*. C. H. ALVEY, New York University.

57. The Life-Cycle of *Sphyranura oligorchis*. C. H. ALVEY, New York University.

58. A Diphyllobothrium from Cats in the Syracuse Region. JUSTUS F. MUELLER, New York State College of Forestry.

59. Polyandry and Polygamy in Parasitic Worms. ALLEN MCINTOSH, Bureau of Animal Industry, Washington, D. C.

SATURDAY MORNING SESSION, DECEMBER 30, 10:00 A. M.; ROOM 202, PIERCE HALL, HARVARD UNIVERSITY. (JOINT SESSION WITH SECTION N, MEDICAL SCIENCES, A. A. A. S.)

Read

60. A Protozoological Survey of 700 College Freshmen. (15 min.) (Lantern.) D. H. WENRICH, R. M. STABLER and J. H. ARNETT, University of Pennsylvania.

61. The Comparative Toxicity of Certain Anthelmintics. (10 min.) (Lantern.) H. W. BROWN and P. D. LAMSON, Vanderbilt University.

62. The Blood Picture in Children in Louisiana (U. S. A.) Infested with *Trichurus trichura*. (15 min.) (Lantern.) G. F. OTTO, Johns Hopkins University.

63. Blood Studies of Experimental Infections with the Dog Hookworm, *A. caninum*. (12 min.) (Lantern.) A. O. FOSTER, Johns Hopkins University.

64. Artificial Immunization of Rats Against Trichiniasis. (15 min.) (Lantern.) O. R. MCCOY, The University of Rochester.

By Title

65. Protozoa from the Intestine of Chimpanzees. ROBERT HEGNER, Johns Hopkins University.

66. Amoebastatic Properties of Dyes upon *Endamoeba histolytica in vitro*. H. TSUCHIYA, Washington University.

67. Further Studies on the Cultivation of *Endamoeba histolytica*. H. TSUCHIYA, Washington University.

68. The Utilization of the Starch-Charcoal Mixture in the Cultivation of Balantidium from Guinea-Pigs. H. TSUCHIYA, Washington University.

69. The Cultivation of the Balantidium of the Chimpanzee in Fecal Extract. FLOYD ATCHLEY, Johns Hopkins University.

70. Notes on Two Coccidia Reported from Man. JOHN F. KESSEL, University of Southern California.

71. The Effect of Atabrine and Plasmochin on the *Haemoproteus* Infection of the Pigeon. G. ROBERT COATNEY, Peru State Teachers College.

72. Helminth Egg Counts Plotted on a Logarithmic Scale. J. ALLEN SCOTT, International Health Division, Rockefeller Foundation, and Department of Public Health, Cairo, Egypt.

73. The Epidemiology of Hookworm Disease in Palestine. J. ALLEN SCOTT, International Health Division, Rockefeller Foundation, and Department of Health, Palestine.

74. Anomalous and Non-Specific Reactions with *Trichinella spiralis* Antigen in Relation to Other Disease Conditions. GEORGE W. BACHMAN, R. RODRÍGUEZ-MOLINA and J. OLIVER-GONZÁLEŽ, School of Tropical Medicine, San Juan, Puerto Rico.

Presidential Address

75. Some Cellular Bases for Immunological Processes in Parasitic Infections. WILLIAM H. TALIAFERRO, University of Chicago. (The Presidential address will be published in the March, 1934, number of the JOURNAL OF PARASITOLOGY).

SATURDAY AFTERNOON SESSION, DECEMBER 30, 2:00 P. M.; ROOM 202, PIERCE HALL, HARVARD UNIVERSITY. (JOINT SESSION WITH SECTION N, MEDICAL SCIENCES, A. A. A. S.)

Symposium on the Typhus Group of Organisms

1. Relationships of Different Types of Typhus Fever. (15 min.) HANS ZINSSER, Department of Bacteriology, Harvard Medical School.

2. Rickettsiae in Tissue Cultures. (15 min.) HENRY PINKERTON, Department of Pathology, Harvard Medical School.

3. Pathological Aspects of Various Diseases of the Typhus Group. (15 min.) S. B. WOLBACH, Department of Pathology, Harvard Medical School.

4. Studies on Rickettsiae-Like Micro-Organisms in Insects. (15 min.) MARSHALL HERTIG, Department of Comparative Pathology, Harvard Medical School.

5. The Basis of Regional Variation in the Virulence of Rocky Mountain Spotted Fever and the Discussion of Reservoirs of Infection. (45 min.) R. R. PARKER, officer-in-charge of the Rocky Mountain Spotted Fever Laboratory, Treasury Department, U. S. Public Health Service, Hamilton, Mont.

This symposium was arranged at the suggestion and with the advice of Professor E. E. Tyzzer, Department of Comparative Pathology, Harvard Medical School. Doctor Tyzzer will open and lead discussion following the presentation of the invited papers.

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ABSTRACTS

1. The Distribution of Flagellates in Termites of the Genus Kalotermes *s. lat.* HAROLD KIRBY, University of California.

Of about 250 species of *Kalotermes,* records exist of flagellates in 53, of which the writer has examined 49. Some genera of polymastigotes occur not only in *Kalotermes* but also in other termites and other animals. Such are *Tricercomitus, Trichomonas, Hexamastix* and *Monocercomonas.* Most, however, constitute three groups, Devescovininae, Calonymphidae and Oxymonadidae, which, except for one calonymphid and one devescovinid from *Holotermes* are known only from *Kalotermes.* Devescovininae, probably a development from the *Eutrichomastix*-type, with addition of a cresta, occur in 46 of 53 hosts. There are 45 species in 10 genera. Three genera including four or five species sometimes occur in one host. Calonymphidae, which occur in 33 of 51 hosts, have from eight to hundreds of nuclei. Some have in each mastigont the same organelles as a devescovinid, including the cresta and a differentiated trailing flagellum. They may have evolved from a devescoinid, higher forms losing the cresta. There are at least eight genera. Two may occur togeher. Oxymonadidae, probably developed from the *Monocercomonas*-type, four equal flagella and have added a rostellum. At most five genera exist in the present material; three are multinucleate. An oxymonad, generally the uninculeate *Oxymonas,* occurs in each *Kalotermes* examined. Hypermastigotes are present in 22 of 53 hosts. In all but two there is one of two genera, *Trichonympha* or *Staurojoenina.* The two exceptions contain six other genera. In all there are, in the species of *Kalotermes* examined, less than 20 species, in contrast to over 100 polymastigotes.

2. Comparative Morphology of the Devescovinid Flagellates of Termites. HAROLD KIRBY, University of California.

Devescovininae in 46 *Kalotermes* have been arranged in ten genera: *Janickiella* and *Devescovina* with eleven species each, *Metadevescovina* with seven, *Gigantomonas* with six, *Caduceia* with four, *Pseudodevescovina* with two, *Parajoenia* and three new genera with one each. All have three anterior flagella and a trailing flagellum, varying from a slender cord to a broad band, which often adheres insecurely to the body surface along the cresta. Blepharoplasts are several granules, closely aggregated or separate and interconnected by fibrils. The cresta ranges from very small to a broad membrane of body length. In two species at least it is capable of independent movement. Sometimes the capitulum of the axostyle is greatly expanded. The posterior part of the trunk is in some species an enlarged, projecting cusp, or at least is stout; in others it is slender. Development of axostyle, cresta and trailing flagellum is unrelated to size of the animal or to possible functional requirements. The simplest parabasal body is short, bacilliform. Lengthening, it extends transversely to the periphery or coils around the axostyle. In *Parajoenia* it is double. In *Pseudodevescovina* there are cord-like appendages, 1–6 along a longitudinal, spiralled limb in one species; 7–19 dependent from a transverse limb in another. Surface microorganisms are of two types: slender rods adhering full length, and spirochaetes adhering by one end. Some species lack surface microorganisms; others have them in characteristic type and distribution. Spirochaetes form anterior or posterior tufts, or completely cover the body. Entozoic microorganisms, in nucleus and cytoplasm, are frequent.

3. The Structure of Trichomonas vaginalis. THOMAS BYRD MAGATH, Mayo Clinic, Rochester, Minnesota.

The detailed structure of *T. vaginalis* has been studied from preparations made by many different methods and from several hundred patients. The point of view has been a comparison with other species in order to determine the significance of various organelles in the determination of species.

4. On an Amoeba Parasitic in Zelleriella (Protozoa, Ciliata). R. M. Stabler, University of Pennsylvania.

Recently Carini (1933) working at São Paulo, Brazil, described the parasitism of Zelleriellas which he found in *Paudicola signifera* and *Engystoma ovale* by organisms of undetermined taxonomic status, which he named *Brumptina brasiliensis* and *Brumptina paulista.* The writer has studied slides of Zelleriella from toads of Arizona and Panama. Many of these ciliates are parasitized, some very heavlly, with organisms which are undoubtedly the same as those described by Carini. These parasites prove to be Endamoebae, with nuclei and cysts typical of this genus. In some cases the amoebae literally fill the cytoplasm of the ciliate, yet this condition does not seem to greatly impair the activities of the latter, as some amoeba-filled forms were found undergoing apparently normal nuclear and cell divisions. Trophozoites and early cystic stages were found in the Zelleriellas, but never cysts with more than one nucleus in any ciliate. Four-nucleate cysts were found, however, on the smears outside the ciliates. These amoebae rest in small pockets in the endoplasm and sometimes two amoebae occupy the same pocket. Also, trophozoites were found with two nuclei. It is interesting that in any one ciliate, all the amoebae are in very nearly the same stage of development, *i.e.,* all cysts or all trophozoites. The correct name for these forms, in view of the present studies and those of Carini, is *Endamoeba brasiliensis* (Carini, 1933) amend. Stabler.

5. A New Species of Nyctotherus *(Protozoa, Ciliata) from a Chinese Frog.* Ralph Wichterman, University of Pennsylvania.

The parasite was found in the large intestine of *Rana spinosa* from Fukien, China, with opalinids and balantidia. Average length 179 μ; average width 121 μ; average thickness 63 μ.

It is generally oval with a thin flattened border or flange aproximately 15 μ wide extending out from and encircling the periphery of the ventral surface of the body proper. The body, dorsally, is irreguarly convex being slightly thicker at the posterior end. Ventrally, it is flattened or sightly concave. Seen from above, the protozoon roughly resembles a man's hat. It is covered with cilia arranged in definite rows. The peristome begins at the top of the oval body and extends half way down, where it meets the cytopharynx at right angles. The cytopharynx extends into the body and takes a large turn posteriorly. Both peristome and cytopharynx, which are on the left side, are lined with membranelles. At the posterior region of the body is a wide, curved tube which leads to the end of the body proper. Near this tube may be seen a large contracile vocuole with several smaller vacuoles.

The macronucleus is similar to *Nyctotherus magnus* Bezzenberger, in that it is above and close to the cytopharynx, and roughly triangular with the end nearest the anterior, rounded. It measures 49 μ by 26 μ. The small oval micronucleus is visible laterally and located in a depression below the anterior part of the macronucleus.

The name *Nyctotherus chèni* is proposed for this new species.

6. A Gregarine Parasitic in the Striped Shore Crab, Pachygrapsus crassipes. Gordon H. Ball, University of California at Los Angeles.

The common striped shore crab of the Pacific Coast, *Pachygrapsus crassipes,* is frequently infected by a cephaline gregarine which inhabits the mid gut and the hind gut of the host. The infection may run from 70% to 100% of the crabs collected; it does not appear to be seasonal or to be connected with the host's ecological habitat. The parasite does not invade the host tissue; all the stages observed, including cysts, young and adult trophozoites, and syzygies inhabit the lumen and may all be present at the same time. Establishment of this gregarine in parasite-free crabs has been effected by feeding them digestive tracts of infected animals. Thus, cannibalism may be one of the principal methods of trans-

fer of the infection in nature since cysts are rare in the digestive tract, particularly in the lower parts; and since also crabs permitted to feed on one another retain their infection longer in the laboratory than do isolated ones. The parasite resembles forms placed in the genus *Uradiophora* by Mercier, but the confused taxonomy of gregarines from Crustacea and the failure so far to find spores do not, at present, warrant a more definite classification. The crabs are for the most part unaffected by the parasite; in exceedingly heavy infections, some of the epithelial and cuticular linings of the gut are thinned out or sloughed off.

7. Rediscovery of Eimeria carinii *Pinto, 1923.* E. R. Becker and R. D. Burroughs, Iowa State College.

Eimeria carinii has been reported only by Pinto (1928), who described it in Brazil from the sporulated forms present in a rat's faeces mixed with potassium dichromate solution that had been sent to him by Dr. Carini. Thus there was no proof that the organism was a true parasite of the rat, for it may have been present in the animal's food. Dr. Asa Chandler sent the writers from Houston, Texas, two vials of dichromate solution each containing the sporulated oocysts of *Eimeria miyairii, E. separata* and a form resembling *E. carinii.* When this material was fed to laboratory rats, the immature oocysts of *E. separata* commenced to appear on the fifth day, those of *E. carinii* on the sixth day, and those of *E. miyairii* on the seventh day. The oocysts of *E. carinii* have the thick, rough, yellowish brown wall described by Pinto. They measure from 16.8 μ to 29.0 μ by 16.1 μ by 26.0 μ; mean, 24.4 μ by 22.1 μ; ratio of mean length to mean breadth, 1.104. The minimum sporulation period in a warm room is 4 days. When the sporulated oocysts are fed once to uninfected rats, oocyst elimination commences on the sixth day and continues for about 5 days. If the infective material is fed on a number of successive days, the animals develop an immunity. During immunization from 9 to 36 million oocysts are passed; mean, 19 million. Some preliminary cross-immunity tests indicate that acquired immunity to *E. miyairii* confers absolutely no protection against *E. carinii.*

8. Artificial Extension of the Intervals Between Oöcyst-Peaks in the Sparrow Coccidium. Donald C. Boughton, Floyd O. Atchley and Lydia C. Eskridge, Harvard University and Johns Hopkins University.

Sparrows (*Passer domesticus*) were maintained on a schedule of 13 hours of darkness (rest, no food) followed by 16 hours of light (activity, food) for 17 days and the average number of oocysts (*Isospora*) per bird determined by a dilution count for each of 68 6-hour intervals. There were 14 "artificial days" of 29 hours each during the experiment. There were 14 oocyst-peaks, one during the light period of each of the "artificial days," as opposed to the 17 expected in birds under normal 24-hour schedules. In every case the actual oocyst-output for the peak period exceeded by a wide margin the expected based on relative fecal weight. Thus the peaks were not due simply to the increased fecal output of the light periods but seem to have been adjusted in some manner to correspond to the "29-hour day" imposed experimentally upon the host.

9. Some Physiological Effects of Coccidia on Chickens. C. A. Herrick, University of Wisconsin.

Studies made on the blood of chickens infected with *Eimeria tenella* showed a marked reduction in total nitrogen, non-protein nitrogen and hemoglobin. The blood sugar was not reduced but tended to increase. The temperature regulating mechanism was so affected that the temperature of the infected chickens was reduced to only a few degrees above that of their environment. After the most severe symptoms were passed the temperature of the infected animals returned to normal.

Studies made on the blood of uninfected chickens bled by cardiac puncture showed that the symptoms produced by coccidia are not due entirely to loss of blood.

10. Effect of Oily Mixtures of Phenolics on the Oöcysts of Poultry Coccidia, with Special Reference to Eimeria tenella. JUSTIN ANDREWS, Johns Hopkins University.

To test the relative merits of different kinds and concentrations of phenolics in light mineral oil in killing or otherwise incapacitating the oöcysts of poultry coccidia, the organisms were immersed in test substances for various lengths of time and were then thoroughly washed. The viability of segmented oöcysts thus treated was determined by chick infection experiments under controlled conditions; of unsegmented oöcysts by examining and counting the segmented and unsegmented oöcysts at varying intervals of time after they had been washed and immersed in a shallow depth of a 2.5% aqueous solution of potassium dichromate. Different commercial samples of crude cresylic and xylenic acids, pure ortho-cresylic, a mixture of meta- and para-cresylic acids, some of the conjugated phenols, and alpha- and beta-naphthols were used in serial dilutions in oil. Most of these products showed some inhibitory effect on the sporulation of öocysts but in the case of cresylic and xylenic acids, this action was more effective. Concentrations of 5% or more serve to kill segmented oöcysts or to prevent sporulation of unsegmented oöcysts as long as the organisms were exposed to their action, most (90% or more) of the organisms being killed in from 24 to 48 hours' exposure. A few may proceed to sporulation after they are washed and placed in a favorable environment. It was shown that the more water there was present with the oöcysts, the less effective was the oily mixture in destroying them. This effect was minimized by the addition of an emulsifying agent to the mixture.

11. An Attempt to Transmit Trichomonas vaginalis *to the Intestinal Tract of Kittens.* JOHN F. KESSEL, University of Southern California.

The question as to whether *Trichomonas vaginalis* and *Trichomonas intestinalis* represent separate or identical species is still undecided. One of the methods of approach to the study of this problem is to endeavor to transplant *T. vaginalis* into the intestinal canal of animals. The kitten, which may be infected easily with *T. intestinalis* of man, should be a suitable animal to employ in such an experiment.

In the present study twelve kittens found to be negative for natural infection of *Trichomonas* were chosen. These were injected per rectum on three different occasions with cultures of *T. vaginalis,* collected from human cases of vaginitis. The stools from the kittens were repeatedly examined for *Trichomonas* for a period of one month, at the end of which time the kittens were sacrified and cultures made of the colon contents. All results were negative. Evidence is thus presented from the point of view of animal transfer experiments that *T. vaginalis* exhibits different environmental characteristics from *T. intestinalis.*

12. The Duration of Malarial Infection in Birds. REGINALD D. MANWELL, Syracuse University.

The question of how long malarial infection lasts in both birds and man is still a moot one. Although it is commonly believed that the former remain infected a very long time—probably for life in most cases—there are nevertheless a number of instances of complete recovery reported. As far as the human malarias are concerned, it is generally believed that the infection dies out as a rule in from a few months to some years, even without treatment, the duration of the infection being dependent chiefly on the species of parasite, the subtropical type persisting for the shortest time and the quartan for the longest.

The investigation here reported covered a total of 112 cases, distributed somewhat unevenly among the five species available for laboratory study, as follows: *Plasmodium cathemerium,* 54; *praecox,* 17; *elongatum,* 15; *circumflexum,* 10; and *rouxi,* 16. All of them were followed for at least a year, and some for as long as three years, periodic blood examinations being made from time to time to determine whether parasites were present. When necessary, subinoculation and splenic examination at autopsy were resorted to. In all cases the canary was the bird used, and nearly all cases were females.

The results showed that parasites were still present in every instance, although their numbers were so small that prolonged and repeated examination of the blood frequently failed to reveal them in certain cases. Even subinoculation of 250 cmm. of blood failed in one case, and a second inoculation was necessary to secure a positive result.

13. The Effect of Rauwolfine on the Avian Malarias. REGINALD R. MANWELL, Syracuse University.

Rauwolfine is the name suggested by Koepfli for a crystalline basic substance obtained by him from the bark of *Rauwolfia caffra,* a tree found in South Africa. Koepfli has determined the empirical formula of rauwolfine to be $C_{20}H_{26}O_3N_2 \cdot 2.5H_2O$, and the trials herein reported were carried out at his request, in order to determine whether it had any of the anti-malarial properties which ahe bark was believed to possess.

Rauwolfine has been tested on birds infected with *Plasmodium cathemerium, praecox* (*relictum*), *elongatum* and *rouxi.* So far it has not been tested on infections of *Ulasmodium circumflexum* because of difficulty in securing an additional supply of the drug. A total of 26 birds has been used, including controls. Treatment was oral in most cases, but in some the drug was administered subcutaneously. The duration of treatment was two weeks (except in one case), and the number of doses per day two. The dosage varied, six mgs. being given in 200 cmm. of water when treatment was oral, and 1 mg. in 100 cmm. of isotonic solution when subcutaneous injection was used.

No evidence of any therapeutic effect could be obtained when rauwolfine was used in treating cases of *Plasmodium elongatum, praecox* or *rouxi,* but there was some indication that infections of *cathemerium* were slightly influenced. Treated cases showed somewhat milder infections than controls, and the duration of the incubation period seemed to be slightly increased.

14. Protozoan Parasites of the Orthoptera, with Special Reference to Those of Central and Southeastern Ohio. FRANK M. SEAMANS, Ohio State University.

An initial study was made, 1932–33, of the protozoan parasites of Orthoptera, temporarily excluding the domestic cockroaches; also *Cryptocercus punctulatus* Scudder, 1862, which harbors, chiefly, symbiotic protozoa. Collections were made comprehensively in Franklin County and the six contiguous counties (central Ohio), and a southeastern portion of Washington County (southeastern Ohio); also, sporadically, in four other counties of Ohio and the Lake Michigan sand dunes of Indiana.

The purpose of the study was to determine the distribution of protozoan parasites among the subdivision of the Orthoptera and, wherever possible, to correlate this information—including stage of parasite and sex and age of host—with all known ecological factors.

The infection statistics were as follows: 99 species and subspecies of Orthoptera examined, with 34 per cent infection; 1287 individual specimens, 19 per cent infection. The families and subfamilies of Orthoptera were parasitized as follows: Blattidae 5 species: 4 with infection; Phasmidae 1: 0; Acrididae, subfamilies: Acrydiinae 5: 2, Acridinae 6: 2, Oedipodinae 12: 7, Cyrtacanthacrinae 17: 8; Gryllacrididae 10: 6; Tettigoniidae 29: 0; Gryllidae, subfamilies: Gryllinae 7: 3, Oecanhinae 3: 0, Trigonidiinae 2: 1, Eneopterinae 2: 1. In the course of the

study, nine formerly described species of protozoan parasites were recognized, and fifteen new species and subspecies.

As an addendum, the protozoan parasites of the Orthoptera of the world were keyed and classified, giving for each protozoan, as completely as possible, a list of references, correlated by a numerical system with lists of synonyms, orthopteran hosts, habitats, and localities.

15. Bovine Coccidia Carriers. Louis V. Skidmore, University of Nebraska.

From 1925 to 1931, inclusive, 23 severe cases of coccidiosis occurred in bovines varying in age from 6 days to 2 years in a dairy herd averaging a total of 125 animals per year. Coccidiosis was observed in every month of the year with the exceptions of January and October. Coccidiosis occurred every year except in 1929. In 1928 and 1929 examination of the feces of older bovines was made to determine the presence of coccidia. On December 31, 1928, the feces of 31 apparently healthy cattle, 2 to 7 years old showed 40 per cent carriers. Most of the carriers were more than 3 years old. Of 26 animals, varying from a few days to 7 months of age 11.5 per cent were carriers. On July 7, 1929, examinations of 31 bovines showed 32.2 per cent carriers. Here, 40 per cent of the carriers were 4 to 9 years old. On December 12, 1929, examination of the feces from 41 cattle, 9.7 per cent were found to be carriers. The three examinations showed that the same animals were not always carriers. In most instances, different animals proved carriers upon each examination. Not any of the carriers showed clinical symptoms of coccidiosis. The voluminous amount of feces to examine and the different periods of development of coccidia in bovines will account for variable results. Likewise, continuous reinfection and intermittent infection with coccidia vary the findings so that it is impossible to state that cattle once found to be carriers are always carriers (chronic carriers). *Eimeria zurnii, E. cylindrica* and *E. smithi* were found.

16. When Are Ascaris Eggs Infective? Norman R. Stoll, Rockefeller Institute for Medical Research, Princeton, N. J.

That eggs of *Ascaris lumbricoides* of man or pig readily develop outside the body to the active embryo stage is well known. Are they then immediately infective? Evidently not. An additional period approximating that required for embryonation itself under given culture conditions has been consistently demonstrated necessary for embryos to become infective. Using guinea-pigs for lung migration tests, in a sample experiment at room temperature eggs embryonating between 16 and 20 days after culturing showed no lung damage when fed at 23, 27, 31 and 34 days, but produced pulmonary ascariasis after feedings at 40 days and thereafter. Eggs either floated from swine feces or removed from adult ascaris uteri give comparable results. Apparently, upon ingestion the newly embryonated eggs hatch poorly, if at all. When fed to previously uninfected swine they have been recovered unhatched in the feces, the pigs developing no signs of infection. When demonstrably infective by guinea-pig test, however, similar feedings have not been similarly recovered, and the swine after a week showed symptoms ascribable to lung damage. Embryonated eggs are less resistant than those not embryonated. For instance, in 10 per cent formalin solution eggs develop and produce characteristically active embryos, but fail, perhaps entirely, to survive the period during which infectivity is established. This suggests greater promise of chemical disinfection against ascaris than hitherto held, by directing attention to the pre-infective embryo stage. Other conclusions resting on the assumption that an embryonated ascaris egg is *ipso facto* an infective egg, may need revision.

17. Resistance of the Cat to Ascaris Infection. Merrit P. Sarles, Rockefeller Institute for Medical Research, Princeton, N. J.

Domestic cats harboring naturally acquired infections of the common cat ascarid, *Toxocara cati* Schrank, 1788, were found strikingly resistant to further

infection. Over two dozen cats were studied, most of them for a 5 month period during which they were protected against natural reinfection. As measured by egg counts and worm counts, single small doses of up to 500 eggs produced no demonstrable infections. Large doses of thousands of eggs given in one dose or in 14 weekly doses of constant or increasing size only occasionally produced an infestation. In such cases the worms were usually immature. Kittens as well as old cats were refractory, although in both the ascaris larvae migrated and produced lung lesions. The infectivity of each dose of eggs was established by the ability of the eggs to cause lung lesions when fed to guinea-pigs. This is emphasized because it was found that a period must elapse before a newly embryonated egg of *T. cati* becomes infective, as Stoll has noted for eggs of *Ascaris lumbricoides*. Migration of larvae with resultant production of lung lesions occurred in mice, rats and rabbits following the ingestion of infective *T. cati* eggs, as well as in cats and guinea-pigs. The nature of the data makes it impossible to determine whether the resistance manifested by the cats was natural or acquired.

18. On the Comparative Resistance of Six Breeds of Chickens to the Nematode Ascaridia lineata (*Schneider*). J. E. Ackert, L. L. Eisenbrandt, B. Gladding and J. H. Wilmoth, Kansas State College.

Four experiments involving 522 chickens were carried out to test the resistance of the following six breeds of chickens to the viability and growth of the intestinal nematode, *Ascaridia lineata* (Schneider): Single Comb White Leghorns, Single Comb Rhode Island Reds, White Plymouth Rocks, Barred Plymouth Rocks, White Minorcas and Buff Orpingtons. The chickens under comparison were of the same age and were given the same number of embryonated eggs of *A. lineata*. The period of parasitism was three weeks. The criteria for judging the resistance were the average numbers and lengths of *A. lineata* from each group of chickens under comparison. There were approximately 50 chickens in each group. From giving 50 (plus or minus 5 eggs) to each chicken (one month old) the Rhode Island Reds averaged 2.84 worms with a mean length of 20.18 mm.; the White Plymouth Rocks, 3.39 worms with a mean length of 20.46 mm.; the Barred Plymouth Rocks, 2.71 worms with a mean length of 19.64 mm.; the White Minorcas averaged 2.51 worms with a mean length of 19.03 mm.; the Buff Orpingtons, 5.25 worms with a mean length of 23.92 mm.; and the White Leghorns, 5.73 worms with a mean length of 23.83 mm. The first four breeds were significantly more resistant to the viability and growth of the worms than were the Buff Orpingtons and the White Leghorns; which were about equally susceptible to the *A. lineata*.

19. Sex Differentiation in Preparasitic Larvae of Hyostrongylus rubidus *and Development of Male and Female Reproductive Systems.* J. E. Alicata, Bureau of Animal Industry, Washington, D. C.

In *Hyostrongylus rubidus* sex can be differentiated even in first stage larvae by the position of the most posterior of the 4 "giant cells" in the body cavity. Preparasitic larvae in which this giant cell is anterior to the genital primordium develop into males, while those in which this cell is slightly lateral or posterior to the genital primordium develop into females. The genital primordium of first stage larvae is composed of 2 epithelial and 2 germinal cells, at first located at a right angle to main axis of body; later the primordium rotates 90 degrees to lie parallel to body wall. In second stage no outstanding change occurs. The primordium in third stage preparasitic male has about 11 epithelial cells surrounding 2 germinal cells. In the third stage parasitic male, the epithelial cells become rearranged so that the germinal cells lie posterior to them; the genital primordium at this time begins to curve laterally and rotates 180 degrees, the germinal cells now being anterior, and the entire structure again parallel to body wall but having its end reversed. Primordia of testes and gonoduct in fourth stage male are well differentiated and the giant cell is now far removed from these primordia.

Structurally the genital primordium of preparasitic female larvae somewhat similar to that of male; in third stage parasitic female, a single germinal cell is located at each extremity of primordium. In early fourth stage the genital primordium is already attached to body wall, and the primordia of the ovaries and gonoduct are well differentiated.

20. Observations on Trichostrongylus tenuis *Infestation in Domestic and Game Birds in the United States.* ELOISE B. CRAM and EUGENIA CUVILLIER, Bureau of Animal Industry, Washington, D. C.

Clinical avian trichostrongylosis has been noted for the first time in this country, outbreaks occurring in native domestic geese in the District of Columbia and in pheasants imported from England into Michigan. The nematodes from both epizootics were identified as *T. tenuis*. In cultures made from cecal contents of infected pheasants, eggs hatched in 36 to 48 hours; the infective larval stage might be reached as early as the 6th day (4th day after hatching). Moisture being present, second-stage larvae, retracted within cuticular sheath, resisted an average temperature of about −3° C. (range: +3° to −20° C.) for 4 months, proving infective for the bird host at end of that period. The chicken, turkey and guinea-fowl were successfully infected with cultures derived from pheasants; attempts to infect the duck and pigeon with cultures from pheasants, and the duck with cultures from geese, were unsuccessful. Development to adults in bird hosts took place in a minimum of 7 days after infection; size of adults varied in different birds, being greater in chicken than in pheasant, and still greater in turkey. In early stages of infection diarrhea from ceca, with passage of mucus and blood, occurred; later all discharge from ceca ceased. Sections of unopened ceca showed worms mostly on surface of mucosa but with penetration of mucosa to ½ its depth by some worms; considerable destruction of tissue was apparent. Blood cells were noted in the parasite's esophagus. In chickens with comparatively small numbers of *T. tenuis*, reinfection being prevented, symptoms were of fairly short duration and the infestation tended to die out in about 2 months.

21. Reaction of Laboratory Rats to Graded Numbers of Nippostrongylus *Larvae.* GEORGE L. GRAHAM, Johns Hopkins University.

Eight groups of rats containing from four to six individuals (6–8 weeks old) were infected dermally with *N. muris* larvae at levels of 6400, 3200, 1600, 800, 400, 200, 100 and 50 larvae per rat. The egg production of the infection produced in each group was followed by means of the dilution egg count on total 48 hour samples. Within determinable limits there did not appear to be any obvious "dampening" of egg production in the more heavily infected groups on the basis of gross egg count or eggs per day per rat per larva except in comparison with the lowest group which contained an individual of a different strain than the others. This may or may not be considered of importance. The egg production of all groups fell to a low level by the 25th day after infection and were not followed by egg counts thereafter. Seventy-six days later when the rats were from 20½ to 22½ weeks old they were exposed uniformly to 600 larvae and the egg production followed. Analysis of the accruing data shows that the egg production of the second infection expressed in terms of larvae administered ranged from three to seven per cent of this function of the initial infection in the four higher groups and from 18 to 81 per cent in the groups initially infected with from 100 to 400 larvae. The division of these relationships are interpreted as showing tangible differences of resistance produced as a result of initial infections of different sizes.

22. A Preliminary Report on the in vitro Consumption of Oxygen by Parasitic Nematodes. PAUL D. HARWOOD and HAROLD W. BROWN, Vanderbilt University.

We have found that female *Ascaris* from the pig per gram of body weight per hour use from 0.03 to 0.045 ml. of oxygen reduced to standard conditions of

temperature and pressure. The males require considerably more under the same conditions using from 0.05 to 0.07 ml. of oxygen. After the *Ascaris* have been two or three days in a physiological saline solution their rate of oxygen consumption begins to fall and just before death may drop to one half the requirements of fresh specimens. Our tests on *Ancylostoma canimum* are not sufficiently advanced to permit an accurate statement as to the amount of oxygen which they require, but it is certainly considerably more than ten times as much per unit of body weight as is used by the female *Ascaris*.

23. Oxidation-Reduction Potential as a Possible Factor in the Growth of Intestimal Parasites in vitro. THEO L. JAHN, Yale University.

It is well known that the optimal oxidation-reduction potential of anaerobic bacteria is quite different from that of aerobic bacteria, and recent work has shown that this difference is not due entirely to absence of oxygen. Oxygen-free media may be poised at a level which is too high to allow the growth of strict anaerobes (Dubos, 1929). It is also known (Plotz and Geloso, 1930) that *Escherichia coli* may lower the potential of the medium more than 500 millivolts.

Many intestinal protozoa have been grown *in vitro* only in the presence of bacteria. From these data conclusions may be drawn concerning the possible functions of the bacteria in cultures of intestinal parasites *in vitro*. (1) Bacteria serve as food for holozoic forms. (2) Bacteria produce chemical changes which allow growth of the parasite. If digested peptones are used for preparing the medium, the most obvious chemical action of the bacteria is to produce a very low oxidation-reduction potential. Measurements of the large intestine and caecum of the white rat with a vacuum tube potentiometer show an Eh value of −195 to −200 mv. This is considerably lower than is obtained in ordinary broth with very strict anaerobic methods (−60 mv.). Therefore, some of the negative results obtained in attempts to grow intestinal parasites free from bacteria might be caused by too high an oxidation-reduction potential in the medium, and the use of media of lower potential is indicated.

24. On the Comparative Resistance of Bronze Turkeys and White Leghorn Chickens to the Nematode Ascaridia lineata (*Schneider*). J. E. ACKERT and L. L. EISENBRANDT, Kansas State College, Manhattan.

Two experiments were carried out to compare the resistance of bronze turkeys and white leghorn chickens of the same age to the viability and growth of the intestinal nematode, *Ascaridia lineata* (Schneider). The individual birds under comparison were given the same number of embryonated eggs of *A. lineata*. The period of parasitism in the first experiment was one month, that for the second, three weeks. In both experiments the turkeys harbored fewer nematodes than did the chickens. In the second experiment the 25 chickens had an average of 6.12 worms per bird and the fifteen turkeys 1.20 worms per fowl. The difference of 4.92 was significant (4.32 times the probable error). Concerning lengths of worms, those from the chickens averaged 26.07 mm. in length and those from the turkeys, 19.57 mm. in length. The difference, 6.5 mm., was 11.82 times the probable error. These results indicate that the turkeys were more resistant to this nematode than were the chickens. There was no evidence that the turkeys are the natural hosts nor that the chickens are abnormal and hence more resistant than the turkeys to this nematode.

25. Control of Swine Kidney Worm. BENJAMIN SCHWARTZ, H. B. RAFFENSPERGER and LLOYD A. SPINDLER, Bureau of Animal Industry, Washington, D. C.

The kidney worm, *Stephanurus dentatus*, one of the most injurious parasites of swine, can be controlled effectively by providing a suitable bare area all around hog pastures. The housing, feeding pen for sows only, creep with self-feeder for pigs, and watering facilities are located on the widest portion of the bare

area (about 30 feet wide), located with reference to convenience at one end of the field; the remaining bare portion need not exceed 5 feet in width. Under these arrangements, a large proportion of the kidney worm eggs eliminated with the urine of infested sows, will be deposited on the bare ground where, under favorable climatic conditions, the eggs and larvae which emerge from eggs will be killed by sunlight and drying. Actual tests on farms in the South have shown that under this system of management, the amount of kidney worm lesions in the liver, loins, and kidneys of pigs is sharply reduced. The lesions in question necessitate trimming or condemnation of affected parts under meat inspection procedure. This constitutes a loss of considerable magnitude. The kidney worm control plan, aside from overcoming losses under meat inspection, is of benefit to the farmer in that it removes, to a large extent, pathogenic agents which interfere with normal growth of pigs and otherwise exert deleterious effects on them.

26. Wanderings of the Filariid Worm, Icosiella quadrituberculata, *in the Bull Frog.* JOHN GIESEN and J. L. WORDEN, College of St. Thomas.

Examination of one hundred Louisiana bull frogs showed over fifty of them to be infested with *I. quadrituberculata.* Adult worms, ranging in length from 10.5 to 12.5 cm. and slightly over 1 mm. in diameter were found in practically all of the organs, tissues and cavities either as encysted forms or free living. Cysts, each containing a single worm, were found between and within the muscles of almost the entire body, particularly in the musculature of the anterior abdominal wall and of the hyoid region. Multiple cysts were found in the ovaries of several specimens. Polyp-like cysts were found suspended from the parietal peritoneum and from the visceral peritoneum of practically the entire digestive tract. Two bladder-like cysts entirely unattached were seen, one in the peritioneal cavity and the other in the sub-dermal space of the deltoid region. Free worms were found in the lumen of the intestinal tract at various levels, one specimen having bored its way through the thick wall of the stomach in such manner that one third of its body was hanging in the body cavity while the posterior two thirds were still in the lumen of the digestive tube. Liver, spleen and lungs seemed to be entirely uninfected.

27. The Characters of a Protonematode. B. G. CHITWOOD and M. B. CHITWOOD, Bureau of Animal Industry, Washington, D. C.

In order that one may study the Nematoda from a logical viewpoint, the writers have attempted to define some of the outstanding features of a form capable of giving rise to the whole Class Nematoda. Both gross and histological studies indicate that an organism combining some of the characters of *Rhabditis* and *Plectus* would fulfill these requirements. Such a form may be described as follows: Cephalic sensory organs consisting of an internal circle of 6 papillae and an external circle of 10 (or ? 12) papillae or setae (possibly an internal, median, and an external circle, each of 6 papillae); amphids slightly postlabial in position, pore-like or unispiral; stoma subcylindrical; esophagus consisting of corpus isthmus, and bulb; intestine of few cells; rectal glands present; cuticle indistinctly striated; hypodermis cellular, having dorsal, ventral, and lateral chords; meromyarian; bisexual, both sexes with 2 gonads; excretory system consisting of lateral collecting ducts and subventral glands; phasmids well developed; caudal glands present. On the basis of this hypothetical prototype a classification may be built in which the Nematoda is divided into 2 large groups, the Phasmidia with *Rhabditis* as the central form and the Aphasmidia with *Plectus* as the central form. In each of these groups meromyarian musculature has given rise to polymyarian musculature several times; the stoma has taken highly varied forms often showing marked convergence; the esophagus has become cylindrical or bipartite; and many other adaptations have occurred.

28. A Revised Classification of the Nematoda. B. G. CHITWOOD, Bureau of Animal Industry, Washington, D. C.

The writer proposes to divide the Class Nematoda into 2 subclasses Phasmidia and Aphasmidia, and to divide each subclass into 2 orders and several suborders, as follows:

I. Phasmidia: Phasmids present; caudal glands absent; sensory organs rarely setose, never in form of distinct setae; somatic sensory organs rare; amphids usually pore-like, labial in position, never externally modified; deirids usually present; subventral esophageal glands never opening at base of stoma; excretory system always having at least one lateral collecting duct; male without a medioventral row of accessory copulatory organs; hypodermis never with nuclei in interchordal areas. Order Rhabditida.—Suborders Rhabditata, Strongylata, and Ascaridata; Order Spirurida.—Suborder Spirurata.

II. Aphasmidia: Phasmids absent or greatly reduced; caudal glands generally present; sensory organs often setose or in form of distinct setae; somatic sensory organs common, numerous; amphids usually externally modified and postlabial in position (externally pore-like in parasitic forms); deirids apparently usually absent; subventral esophageal glands sometimes opening at base of stoma; excretory system usually consisting of a single ventral gland; lateral collecting ducts rare; male often with a medioventral row of accessory copulatory organs; hypodermis sometimes with nuclei in interchordal areas. Order Chromadorida.—Suborders Chromadorata; Desmoscoleata, Monhysterata. Order Enoplida.—Suborders Enoplata, Dorylaimata; Appendix.—Dioctophymata.

29. Notes on the Economic Importance, Life History, and Control of Moniezia expansa *Rudolphi, the Common Tapeworm of Sheep.* STANLEY B. FREEBORN, University of California.

The presence of ordinary infestations of this tapeworm does not influence the growth rate of infested lambs but does affect their condition, marketability, and value. Normally infested lambs harbor the parasites for from six months to a year but have thereafter remained apparently immune for at least seven months. Successfully treated lambs have remained uninfested for ten months but others have become reinfested in eight. It has not been possible to confirm the observations of Sinitsin concerning the development of the oncospheres and all attempts to infest susceptible lambs protected against other sources of infestation have failed except in one case where a cysticercoid larva was taken from the jejunum. Hall's mixture (1 per cent copper sulfate and 1 per cent Black Leaf 40) proves to be practically a specific and a dry mixture of anhydrous copper sulfate and Black Leaf 40 administered in capsules gives equally satisfactory results.

30. The Molluscan Phase of the Life Cycle of Schistosoma mansoni. ERNEST CARROLL FAUST, Tulane University, and WILLIAM A. HOFFMAN, Puerto Rico School of Tropical Medicine.

In nature 50 per cent of a sampling of *Planorbis guadeloupensis* from endemic foci may be infected but the incidence is usually much lower. Under experimental conditions the infection may be 100 per cent. First generation sporocysts, dissected out of the periesophageal tissues, were first recognized 8 days after exposure of the snail. By the fifteenth day second generation sporocysts were obtained from the apical intrahepatic lymph spaces, and a single mature first generation form, with various stages of daughter sporocysts was recovered from a more proximal level. By the twenty-fourth day young cercariae within second generation sporocysts were found in the apical regions of the snail. Mature cercariae first erupted spontaneously from the snail as early as the twenty-fourth day and as late as the thirty-seventh day, depending on temperature conditions and the age of the snail. High mortality prevails in the infected snails for the first few days following maturity of the cercariae, but

those snails which survive this critical period may then discharge cercariae for several months. Snails exposed to a single miracidium may produce many tens of thousands of parasitic progeny (cercariae). The structure of the miracidium, sporocysts and cercariae have been studied and will be presented in detail.

31. The Miracidium of Clinostomum marginatum (*Rud.*). WANDA SANBORN HUNTER and GEORGE W. HUNTER, III, Wesleyan University.

The miracidium of *Clinostomum marginatum* (Rud.) is characterized by 21 epidermal plates arranged in four transverse tiers (6, 8, 4, 3 respectively from the anterior end). The subepithelium is composed of small nucleated cells. A protrusible anterior papilla bearing a stylet is present; this may be withdrawn into the apical gland. Three pairs of penetration glands open on the papilla. Many large nucleated cells are scattered throughout the anterior two-thirds of the miracidium. A small papilla is found laterally between the first and second rows of plates. Three prominent eyespots lie anterior to the bilobed "brain." Two pairs of flame cells open through an excretory pore between the second and third rows of epidermal plates. A well developed germ ball is present.

32. The Plerocercoid Larva of the Bass Tapeworm, Proteocephalus ambloplitis (*Leidy*), *in the Small-Mouthed Black Bass.* GEORGE W. HUNTER, III, and A. V. HUNNINEN, Wesleyan University and Johns Hopkins University.

Data gathered on the bass tapeworm, *Proteocephalus ambloplitis* (Leidy), from 183 heavily infected small-mouthed black bass, *Micropterus dolomieu* Lacépède, from the Raquette watershed and the St. Lawrence River indicate that more plerocercoid larvae (average of 13) occur in the mesenteries of sexually immature fish (1 to 2 years old) than in the gonads (4), liver (3), and spleen (1+). In sexually mature fish the gonads and mesenteries average equal numbers (18) while the liver and spleen average about 7 and 3 larvae respectively. Furthermore, measurements of 658 and 1,425 plerocercoid larvae from the gonads and other visceral organs gave a mean length of 10.7 ± 0.171 mm. and 6.2 ± 0.067 mm. respectively; larvae from the ovary reach a maximum average length of 14.1 mm. compared with 6.7 mm. for those from the testes. Evidence is also presented to show that the numbers of plerocercoid larvae increase with the age of the bass up to the 9th year, after which the numbers decrease as the fish grows older.

33. Diplostomulum of Triturus viridescens. C. RUTH SHAW, University of Pittsburgh, and Kent State College.

The *Triturus viridescens* Raf. (common newt) of Seaton's Lake (10 miles east of Uniontown, Penna.) have been found to be heavily infected with trematodes. The most interesting of these parasites is a *Diplostomulum* larva found in 123 of the 128 newts examined. The majority of the diplostomula occur within the cavities of the brain, but frequently in the humors of the eyes, also. It is similar to *Diplostomulum scheuringi* Hughes (found in the eyes of certain fishes), but it is thought that it will prove to be a new species. The author is aware of no other record of an Amphibian *Diplostomulum* larva. Examinations of *Triturus viridescens* from numerous other localities for the *Diplostomulum* have brought only negative results, with one exception.

34. Some Host Parasite Relationships of Fish Parasites of the Trout Lake Region of Northern Wisconsin. S. X. CROSS, University of Wisconsin.

Perch of the region have been examined for parasites using the same specimens used for growth studies. This made possible a grouping of the fish by ages using the actual age of each specimen. Such groups show a decided difference in average length and weight when negative fish and those heavily infected are placed in separate groups. A survey of the fish parasites of the region indicates that large numbers of some parasites have a definite retarding

effect on the growth of their hosts. In a lake where heavy infections with both adult cestodes and adult acanthocephala are present Ciscos are found to harbor few specimens of one of these parasites when large numbers of the other species are present in the same host. Large numbers of parasites of one species are shown to have a limiting effect on the numbers of parasites of other species harbored by a single host. Perch and Small Mouthed Black Bass in a small soft water lake were entirely free from trematode cysts in 1931 and 1932. In 1933, after two summers of fertilization of the lake with calcium and phosphorus fertilizers, the fish examined were six per cent infected with strigeid cysts. Several specimens taken also harbored *Clinostomum marginatum* cysts. This seems to be paralleled by an increase in the snail population following fertilization of the lake.

35. An Apparent Case of a Pathogenic Rotifer (Order Bdelloida) in Man. JOHN GIESEN, College of St. Thomas.

Recently two specimens of urine were sent to the writer from St. Mary's Hospital, Milwaukee, Wis., in which a considerable number of Rotifers of the order Bdelloida were found. Symptoms exhibited by patient were sore throat, pains in the joints which were migratory in nature, affecting different joints successively, acute stomach disorders with vomiting of bile, spells of nervousness followed by weakness and exhaustion, semi-coma and a severe burning sensation around vagina. Blood counts showed an enormous increase in leucocytes.

36. Ova of Diphyllobothrium latum *in the Intestinal Contents of an Esquimo Mummy from Greenland.* T. B. POTE, Washington University.

37. Observations on the Intestinal Protozoa of Young Pigs and Attempts to Produce Infection with a Human Strain of E. histolytica. WILLIAM W. FRYE and HENRY E. MELENEY, Vanderbilt University and Tennessee State Department of Public Health.

Ten young pigs, all from the same litter and averaging 7.5 Kg. in weight, were examined for naturally acquired intestinal protozoa. Fresh smears, stained preparations and cultures were used for identification. *Iodamoeba* and *Endamoeba debliecki* were found in all ten pigs, *Endamoeba polecki* and *Balantidium coli* in nine, *Trichomonas* in eight and Coccidia in one. The morphological differences between *E. debliecki* and *E. polecki* are so distinct as to warrant their designation as separate species. *E. debliecki* grew in Boeck-Drbohlav-rice flour medium but *E. polecki* did not. *Balantidium coli* was eliminated by a single dose of dihydranol and the other protozoa by ten days' treatment with carbarsone. *Iodamoeba* reappeared in two animals. One week after the completion of the carbarsone treatment, the pigs were inoculated (by laparotomy) into the terminal ileum with good cultures of a strain of *E. histolytica* which had produced a high incidence of infection in kittens. One animal passed *E. histolytica* cysts on the second day, another on the second and third day after inoculation. Both were negative thereafter and none of the ten established an infection. Twenty-two days later five of the pigs were placed on a high carbohydrate diet; the others on a high protein diet. All were then inoculated again with *E. histolytica* by ileum. Two animals died from the operation. The other eight failed to establish the infection. Later six of the pigs were repeatedly inoculated by rectum without a positive result. Attempts to produce amoebic liver abscess in two pigs also failed.

38. Notes on the Life History of Halipegus occidualis *(Stafford, 1905) in the Green Frog,* Rana clamitans. WENDELL H. KRULL, Bureau of Animal Industry, Washington, D. C.

A fluke occurring under the tongue of the frog, *Rana clamitans,* has been identified by *Halipegus occidualis.* Metacercariae of *H. occidualis* occurring free in the abdomen of the dragonfly *Libellula incesta,* were fed to experiment frogs

and were mature and about 1 mm. in length in 20 days. The fluke can be transferred from the mouth of one frog to another. Eggs of *H. occidualis* hatched when eaten by the snail *Helisoma antrosa* and the snail became infected. This snail is the natural first intermediate host in this vicinity. The cystoid cercaria is 76 μ in diameter and similar to *Cercaria sphaerula* Thomas, 1932; it has a "handle" which when compressed by *Cyclops* sp., while attempting to eat the cyst, releases the contained worm-like larva. This larva is discharged through the "handle" and tube, which is 458 μ in length, into the cyclops' mouth, thus compelling the cyclops to eat it. Cercariae may be readily discharged also by pressing the "handle" to the substratum with a blunt instrument. It has so far been possible to infect only immature cyclops. The cycle of the fluke, apparently, is completed by the dragonfly eating infested cyclops. All hosts in this investigation were laboratory raised. Metacercariae which appear to be identical with those of *H. occidualis* have been found free in the body cavity of the damselfly, *Lestes rectangularis,* in the Douglas Lake region, Michigan. On publication the paper will contain a redescription of the adult fluke.

39. Notes on the Life History of a Frog Bladder Fluke. Wendell H. Krull, Bureau of Animal Industry, Washington, D. C.

Infections with an undetermined species of frog bladder fluke have been obtained in experiment frogs, *Rana clamitans.* Thirty-six control frogs were used in the experiment. The clam *Musculium partumeium* is the first intermediate host, and the snail *Helisoma antrosa* is the second intermediate host of the parasite. Snails, *H. antrosa,* have been experimentally infected by feeding them cercariae from clams *M. partumeium,* and the resulting metacercariae when fully developed have been used in infecting frogs. The hosts involved in this investigation were laboratory raised. The cystocercus cercaria which develops in large sporocysts in the gills of the clam has an immobile, transparent and almost structureless tail averaging 6 mm. long. The chamber part of the tail for the cercaria body average 372 μ long by 196 μ wide. The encysted metacercariae in naturally or experimentally infected snails were usually localized in tissues surrounding the intestine at the level of the heart. The fully developed metacercaria is larger than the cerceria body, the sensory hairs on the suckers have disappeared, the large excretory bladder is filled with granules, and the cercaria stylet which averages 34 μ long by 8 μ wide has been discarded and is free in the cyst. This fluke belongs to the genus *Gorgodera.*

40. Plagitura parva *n. sp. from* Triturus viridescens. H. W. Stunkard, New York University.

Specimens of *Plagitura* which are distinctly smaller than *P. salamandra* are common in the intestine of *T. viridescens* from the New York area. In these worms the suckers are smaller than those of *P. salamandra,* the gonads are relatively much larger and are situated more posteriorly in the body. These differential characters distinguish a new species for which the name *P. parva* is proposed. Sexually mature worms measure 1.2 to 2.3 mm. long and 0.4 to 0.6 mm. wide. The cuticula in the anterior region of the body is spined. Acetabulum at the caudal end of the anterior third of the body, 0.15 to 0.2 mm. in diameter. Oral sucker from 0.13 to 0.15 mm.; pharynx 0.08 to 0.1 mm. in diameter. Prepharynx short, esophagus long, digestive ceca end blindly immediately anterior to the testes. Testes spherical to oval, slightly lobed, 0.16 to 0.26 mm. in diameter, situated on opposite sides in the posterior third of body. Ovary spherical to oval, 0.12 to 0.18 mm. in diameter, on the right side, behind and partially overlapping the acetabulum. Seminal receptacle and Laurer's canal present. Genital pore just posterior to the bifurcation of the alimentary tract, slightly left of the median plane. The metraterm is on the left, the cirrus sac on the right side of the body. The cirrus sac is slightly longer than the metraterm and may extend almost to the anterior margin of the ovary. Eggs oval, thick shelled, operculate, measure from 0.03 to 0.035 by 0.017 to 0.022 mm.

41. The Life-Cycle of Plagitura parva. H. W. STUNKARD, New York University.

Adults occur in the intestine of *Triturus viridescens*. When passed by the newts, eggs of the parasite contain partially or fully formed miracidia. The larvae become active in two or three days but do not emerge in water. They readily hatch when eaten by the snail, *Helisoma antrosa*. Experimentally infected, laboratory raised snails yield cercariae in about five weeks. Similar attempts to infect other species of snails, *Physella heterostropha, Lymnaea stagnalis, Pseudosuccinea columella,* and *Campeloma sp.* have given only negative results. In *H. antrosa* the interlobular lymph spaces of the digestive gland become filled with colorless sporocysts in which the cercariae develop. The cercaria has a stylet, penetration glands around the acetabulum, and cystogenous glands scattered over the cortical region of the body. The body measures 0.12 to 0.25 mm. long and 0.07 to 0.10 mm. wide. The tail is 0.05 to 0.12 mm. long. Oral sucker 0.04 to 0.05 mm., acetabulum 0.03 to 0.035 mm. in diameter. Cercariae tend to remain near the bottom and are positively phototropic. They penetrate into various invertebrate animals. Encystment and development to metacercariae have been obtained in larvae of the Dobson fly, *Corydalis cornuta* and in the foot and mantle of *P. heterostropha, L. stagnalis, P. columella,* and *Campeloma sp.* Cercariae do not attack *H. antrosa*. Experimentally infected intermediate hosts have been fed to newts and the young worms recovered later from the intestine. Sexual maturity is attained in from two to three weeks.

42. Life History of Macroderoides typicus. DONALD B. MCMULLEN, Monmouth College.

Macroderoides typicus, from *Amia calva,* was first described by Winfield (1929) as *Plesiocreadium typicum,* type species of a new genus placed in the Allocreadiidae. Van Cleave (1932) presented evidence that it belonged in the Plagiorchidae, genus *Macroderoides*. The life cycle supports this view. The cercaria of this species described by Brooks (1930), is a Xiphidiocercaria developing in sac-like sporocysts in *Heliosoma trivolvus* and *H. campanulatus*. Tadpoles serve as the second intermediate host. The metacercariae are immediately infective after encystment in the tadpole. Six Amia were fed one experimentally infected tadpole each. Eleven others were used as controls. In the experimental animals the largest number of worms recovered from one animal was 1392, with an average of 617 per animal. In the controls the highest was 28, with an average of 8. Development stages were followed and mature eggs were found 6 months after feeding. In the cercaria the excretory bladder has a long stem with two short lateral branches just back of the acetabulum. For a short time after excystment the fluke has a bladder like that found in the cercaria. As the body lengthens in development the stem of the bladder shortens and the lateral branches almost disappear. After 7 days the bladder has assumed the short bag-like shape of the adult.

43. Resistance of Terns to Infestation with Cryptocotyle lingua (Creplin). CHARLES H. WILLEY, New York University.

It has been frequently observed that after a severe infestation with parasitic flatworms, the host may undergo recovery and rid itself of all or almost all the worms. Following this stage, although continually exposed to reinfection, the host harbors only a very few sexually mature parasites, while huge numbers of immature worms are continually evacuated in the feces. Observations made on the infestation of young terns, *Sterna hirundo*, with *Cryptocotyle lingua,* indicate that within ten days to two weeks after an initial very heavy infestation the birds begin to lose their parasites and show only a very few eggs or none at all in the feces. Continued ingestion of the larval stages results in the passing of enormous numbers of immature worms. Such young terns killed during the height of the infection yield thousands of mature worms

in the intestine, whereas those killed after the infection has subsided yield very few or no adults, indicating the development of a type of resistance to further infestation. These observations on experimentally fed young terns are supported by data from adult terns in which only occasional adult specimens of *Cryptocotyle* are to be found among a great many immature worms, although the birds are continually exposed to reinfection. This is equally true for adult terns fed in the laboratory for several weeks and those autopsied immediately after having been caught.

44. The Susceptibility and Immunity of Certain Marine Fishes to Epibdella melleni *MacCallum, a Monogenetic Trematode.* R. F. Nigrelli and C. M. Breder, Jr., New York Aquarium and New York University.

Epibdella melleni is a monogenetic trematode that infected the skin and eyes of many of the marine fishes present in the New York Aquarium. Most of the fishes infected belong to the spiny-rayed group (Acanthopterygii). It was found that with the addition of new fishes, collected from Bermuda and Key West, to the tanks of the New York Aquarium, a severe outbreak would invariably occur, the parasites already present in the tanks increasing in great numbers within a month. During these periods it was noticed that the older fishes of the Aquarium developed an immunity. The degree of immunity produced showed no consistency, varying greatly between members of the same family. In analyzing the data obtained in this study, it was found that (a) some fishes acquired a partial immunity; (b) some acquired an immunity lasting for as long as two years (total immunity?); (c) certain fishes that appeared to have a natural immunity became slightly infected during the periods of heavy epidemics, and (d) certain fishes were always susceptible and showed a heavy or light infection. An apparent inverse age immunity was present in the case of *Pomacanthus arcuatus*, black angelfish. In this case the young acquired an immunity after a very short period of susceptibility (one to two weeks), whereas the older specimens in the Aquarium were always parasitized. In the case of *Vomer setapinnis*, moonfish, a skin immunity was demonstrated. Reinfection never took place in the region of a previous infection, indicating a tendency toward localized immunity.

45. Some Trematodes of the Common Bullhead Ameiurus nebulosus (*Le Sueur*). John G. Arnold, Jr., New York University.

The material used for study was collected during a biological survey made under the auspices of the New York State Conservation Department. Ninety-four common bullheads were examined. Based upon morphological study a new genus is proposed to contain *Allocreadium ictaluri* Pearse 1924 and *Allocreadium halli* Mueller and Van Cleave 1932. A new species of *Catoptroides* was found. *Acetodextra amiuri* (Stafford 1900) Pearse 1924 was found in large numbers and a further description of the species is made. This work will appear soon in the Transactions of the American Microscopical Society.

46. Sterrhurus *sp., a Hemiurid from the Gills of the Cutlass Fish* (Trichiurus lepturus *L.*) R. F. Nigrelli and H. W. Stunkard, New York Aquarium and New York University.

More than three hundred individuals of *Sterrhurus sp.* were taken from the gills of a single specimen of *Trichiurus lepturus* L., which is found in the Western Atlantic, north to Virginia, and straggling to Massachusetts Bay. It is common in the Gulf of Mexico. The fish depends mostly on plankton for food, and this fact may be of importance in suggesting possible life history studies of the parasite. There are six species of *Sterrhurus* described from the stomach and intestine of marine fishes. The present form is the first to be recorded from the gills. Odhner (1911) described the following as hemiurids from branchial cavities: *Accacoelium contortum, Syncoelium, Otiotrema, Bathycotyle,*

and *Liocerca*. Manter (1925) described a species, *Gonocerca phycidis*, from the gills of *Urophycis chuss*. Fuhrmann (1928) contended that none of the above forms, except *Gonocerca*, belong in the family Hemiuridae. However, it should be noted that the latter species is a "non-appendiculate" worm and in this respect differs from *Sterrhurus* sp., which possesses a well developed "tail." The parasites from *T. lepturus* agree in morphological features with the genus *Sterrhurus*, in which size and shape of the vitellaria are regarded as specific characters. In the present worms there are two small and slightly lobed vitellaria which appear different from those in other described species. Although it has not been definitely allocated, the above fact together with the new site of infection, may show it to be a new species.

47. Further Studies on Heterophyidae from Fish. JUSTUS F. MUELLER, N. Y. State College of Forestry.

The genera of fish trematodes brought together under the Heterophyidae by Van Cleave and Mueller on the basis of their general morphology have been restudied in detail to check this allocation. *Vietosoma* is found to have a true cirrus sac, a dorsal ovary, and lacks a seminal receptacle, and is hence excluded from the Heterophyidae. The genera *Allacanthochasmus*, *Acetodextra*, *Cryptogonimus*, *Caecincola*, and *Centrovarium* possess a common structural plan. The excretory bladder is Y shaped, the ovary ventral, and lobate, and the seminal receptacle lies dorsal and anterior to the ovary. Laurer's canal is present and opens to the dorsal surface in the midline posterior to the ovary. The yolk reservoir lies posterior to the seminal receptacle in the angle between the oviduct and Laurer's canal, its lateral ducts slanting backward at an angle to meet it. In the Heterophyinae the cells of Mehli's gland form a central cluster surrounding the ootype. In the Neochasminae they lie peripheral beneath the subcuticula, and their long necks pass radially inward to the ootype. In all cases the neck of the uterus emerges from the ootype and loops over the anterior surface of the oviduct before passing posteriad. The male system consists of a seminal vesicle, followed by a prostate portion, and an ejaculatory duct, opening into the hermaphrodite duct. In *Centrovarium* the prostate cells are poorly developed. In all others they are large, and numerous, and their bodies lie peripheral near the subcuticula. Contrary to Osborn (1910) *Cryptogonimus* possesses a seminal receptacle and typical Laurer's canal. These studies will shortly appear in detail.

48. Gyrodactylus *as a Parasite of the Tadpoles of* Rana catesbiana. H. W. STUNKARD and F. W. DUNIHUE, New York University.

Species of *Gyrodactylus* have been described from many groups of fishes but apparently have not been reported previously from amphibians. Tadpoles of *Rana catesbiana* collected in southern New Jersey were heavily infected by a species of *Gyrodactylus*. The parasites occur over the entire surface of the body but are most numerous on the tail fins, particularly at their junction with the median portion of the tail. The worms feed on the epidermis and portions of the tail may be almost denuded. The average length of living specimens is from 0.2–0.5 mm. The two great hooks measure about 0.06 mm. in length and have cuticular accessory pieces. The proximal transverse clamp of these hooks is shaped like a bow with a thickened portion near the middle. The more distal clamp bears a flat brush-like projection. Further studies may show these specimens to belong to a new species.

49. Dicrocoelium lasiuri *n. sp.* (*Trematoda, Digenea*) *from the Liver of a Red Bat.* ALLEN MCINTOSH, Bureau of Animal Industry, Washington, D. C.

Macy (1931) described the first species of *Dicrocoelium* indigenous to North America. A brief description of a second species, collected from *Lasiurus borealis*, in the District of Columbia, follows.

Dicrocoelium lasiuri n. sp. Body lancet-shaped, 2.47 mm. long by 650 μ wide, anterior sucker 160 μ and acetabulum 170 μ in diameter. Ceca ending at posterior

third of body. Testes 140 μ to 190 μ in diameter, subtriangular, lobed or irregular in outline, somewhat obliquely situated. Vasa efferentia unite near level of anterior margin of acetabulum, forming a short vas deferens which passes immediately into cirrus sac. Cirrus sac between acetabulum and intestinal fork. Genital pore at fork of intestine, 340 μ from anterior end of body. Ovary 200 μ to 210 μ in diameter, somewhat irregular in outline, situated immediately caudal to posterior testis. Laurer's canal and Mehlis' gland present. Vitellaria in zone occupied by postovarian portion of ceca, arranged in two lateral groups of approximately 20 follicles each. Uterus filling posterior portion of body and extending anteriorly in median field to genital pore. Eggs 38 by 22 μ.

Dicrocoelium lasiuri differs from *D. rileyi* Macy, 1931, a closely related bat species, in that the ovary of *lasiuri* is as large as or larger than the testes, whereas the ovary of *rileyi* is much smaller than the testes; *D. lasiuri* has twice as many vitellene follicles as *D. rileyi*. In Macy's key (September, 1931, issue of this journal) *D. lasiuri* will key out with *D. panduriforme* Railliet, 1900. The latter is a bird parasite with a huge acetabulum.

50. Naobranchia wilsoni, *a new copepod from the gills of* Diodon hystrix *L.* R. F. Nigrelli, New York Aquarium and New York University.

More than one hundred and fifty copepods were taken from the gills of a single specimen of a porcupine fish, *Diodon hystrix*. This fish is common in tropical seas and the individual on which the parasites were found came from Bermuda. *Naobranchia wilsoni* differs from previously described species in that it lacks both a mid-dorsal ridge on the trunk and lateral ribs supporting the ovisacs; base of the second maxilla decidedly prominent; the bands are narrower and possess but one muscle strand instead of three. In some individuals the two maxillae are crossed instead of parallel to each other. Ovisacs on level with (if not above) the dorsal surface of the trunk; posterior tips of the trunk enclosed by the envelope of the ovisacs. The total length of the parasite varies from 3.5 to 6.1 mm., averaging 5.28 mm. The cephalothorax is approximately the same length as trunk, measuring 2.9 mm. At the base of the "neck," there are two dorsal semi-annular swellings with a deep groove, but less pronounced than in closely related forms. The length of the trunk measures 2.39 mm., ovisac 2.85 mm. In addition to the above characteristics of the ovisacs, they are further divided into a smaller anterior and a larger posterior part by an annular muscular septum. Width of cephalothorax (at the base) 1.25 mm., trunk 2.30 mm., ovisac 0.76 mm., second maxilla 0.55 mm. No males have as yet been found.

51. Warble Injuries to Reindeer Hides. W. E. Dove and E. C. Cushing, Bureau of Entomology, Savannah, Ga.

In Alaska warble injuries persist in the skin of living reindeer for more than an entire year. Injuries resulting from old cysts of *Oedemagena tarandi* Linn. (Diptera: Oestridae) do not heal before the generation of warbles of the following year make new cysts in the skin. These observations show that in order to produce "warble free" skins it will be necessary to prevent infestations by young warbles and allow more than a year for healing of old warble injuries.

52. Migration of Warbles in Reindeer. W. E. Dove and E. C. Cushing, Bureau of Entomology, Savannah, Ga.

Different workers report young migratory larvae of *Oedemagena tarandi* Linn. in connective tissues beneath the skin of reindeer, but none were able to find such larvae in the vicinity of the oesophagus. Our observations on several hundred slaughtered animals tend to confirm these findings and suggest to us that following penetration of the skin young warbles take an upward course in connective tissues, and that they do not make extensive excursions like *Hypoderma* in cattle. In at least one instance we demonstrate that a larva remained in the subcutaneous tissue near a hair follicle for 26 days before its migration. The larva is demonstrated in serial sections of excised skin.

53. Further Studies on the Biology of the Pigeon Fly, Pseudolynchia maura *(Diptera, Hippoboscidae).* Margaret Jo Prouty and G. Robert Coatney, Nebraska Wesleyan University and Peru State Teachers College.

In a previous report (1931), the junior author called attention to the longevity, offspring per female, breding places, hosts other than the pigeon and certain other points in the biology of *Useudolynchia maura.* This paper deals with a continuation of the former studies with special emphasis on tropisms and the part they play in laboratory feeding experiments. From the evidence at hand these insects are positively thermotropic and thigmotropic; negatively phototropic and hydrotropic. The flies react positively to the odor of oil of cloves, camphor, and ox gall; negatively to oil of wintergreen and amyl alcohol, and are indifferent to fresh blood, fresh pigeon skin, pigeon scales, feathers, ammonia, oil of thyme, oil of origanum, xylol, and bergamot. The length of life without food is found to be in direct proportion to the energy expended in motion, ranging from 77 to 109 hours. During the feeding experiments it was learned that flies would not attempt to imbibe food except through a membrane and only then if the materials were heated to body temperature. Thirteen different foods were offered, only five of which were actually ingested, namely, fresh pigeon blood, raisin juice, whole milk, bovine serum, and saturated sucrose solution. The feeding experiments were not considered successful for none of the insects lived longer than 117 hours.

54. Eleven Cases of Amoebiasis in Reptiles. Herbert L. Ratcliffe and Quentin M. Geiman, Zoological Society of Philadelphia and the University of Pennsylvania.

Acute intestinal disease in the following reptilian species, 1 *Varanus varius,* 1 *Tiliqua scincoides,* 1 *Pseudoboa clelia,* 1 *Lampropeltis getulus,* 1 *Natrix sipendon* and 6 *Natrix rhombifer* was associated with infection by histolytica-like amoebae. In 5 *N. rhombifer* enteritis was accompanied by liver abscesses and, in one of this group, by gastric ulcers also. Another of this species had gastric ulcers without involvement of the liver or of the lower intestine. Lesions of the gastric mucosa occurred in all parts of the organ as circumscribed areas of necrosis and ulceration accompanied by acute inflammatory changes. Below the stomach the disease involved the distal small and entire large intestine. The gut wall was thickened, injected and turbid and the mucosa ulcerated and covered by exudate. Liver abscesses were multiple, discrete or conglomerate and usually larger in the cephalic half of the organ. Amoebas were seen in sections of all of the diseased organs and were associated with the lesions. Amoebas, seen on smears prepared from lesions in the 6 cases involving *N. rhombifer* and fixed and stained according to standard methods, were identical with those in tissue sections from all cases. Five strains from *N. rhombifer* are being cultivated on 0.5 per cent saline-horse serum 9:1+ rice starch. The close similarity of this organism to those from other reptilian and amphibian hosts as well as to *Endamoeba histolytica* necessitates further study for species identification other than *Endamoeba* sp. of reptiles.

55. Effect of Quinine upon Reproduction of the Avian Malaria Parasite, Plasmodium cathemerium. Geo. H. Boyd, University of Georgia.

The rate of multiplication of the malaria parasite is dependent upon two variable factors, namely, (1) the number of merozoites produced by a single schizont in its reproduction process, and (2) the frequency with which such reproduction occurs. Through enumerative studies upon the blood of female canaries infected with *Plasmodium cathemerium* the author finds that the first of these two factors is subject to considerable variation, even in the absence of treatment or other experimental conditions. Under quinine treatment the range of this variation is increased. Administration of ¼ to ½ mg. quinine hydrochloride per day in the acute stage of infection results in a consistent decline in the number of mero-

zoites produced by a single schizont. In practically all cases studied this decline has continued to such level that the number of parasites being produced was less than the number ordinarily destroyed by the host each day. The counting of merozoites is found to be greatly facilitated by exposure of blood smears to ether vapor before the smears have had time to dry.

56. Sphyranura oligorchis *n. sp. from* Necturus maculosus. C. H. ALVEY, New York University.

Specimens of *Sphyranura* from *Necturus maculosus* of the Pennsylvania area differ from *S. osleri* in the presence of fewer testes, vestigeal seminal receptacles, scattered, lobulated vitelline follicles, and a region of densely packed cells located between the caudal suckers. These differences adequately distinguish a new species, for which the name *S. oligorchis* is proposed. Sexually mature worms measure 2.5 to 3.5 mm. long and 0.3 to 0.4 mm. wide. The caudal lamina located posteriad, measures 0.7 to 0.8 mm. wide and 0.35 to 0.47 mm. long. The thick cuticula is raised at regular intervals into sharp, cone-shaped evaginations. The strongly developed caudal lamina bears two suckers, two large hooks, and sixteen small hooks. A heavily staining area of cells is located between the caudal suckers. Terminal oral sucker weakly developed, opening into a short prepharynx. Pharynx well developed, digestive ceca anastomose posteriorly above the caudal lamina. Five to seven spherical to oval testes, 0.08 to 0.16 mm. in diameter, located mediad in the middle half of the body. Ovary 0.065 to 0.13 mm. in diameter, on left side in anterior third of the worm. Scattered vitelline follicles laterad of testes. Genital pore slightly to left of median plane and posterior to intestinal bifurcation. Cirrus sac opens into common genital atrium. Eggs oval, operculate, 0.28 to 0.41 mm. long, 0.14 to 0.18 mm. wide. About five per cent have projections at narrow end.

57. The Life-Cycle of Sphyranura oligorchis. C. H. ALVEY, New York University.

Eggs of *S. oligorchis* from *Necturus maculosus,* collected by isolating worms in watch glasses, were kept in tap water at room temperature (24–32°) for daily observations. After 15 to 16 days of continued cell division, organization of the cell mass begins; at 22 days the embryo shows definite form; at 24 days it has a delicate limiting membrane; at 28 days the caudal disc and hooks appear; at 29 days the embryo manifests activity and suckers appear; at 32 days hatching occurs. At time of hatching it has adult shape, small hooks well developed, large hooks and caudal suckers not fully developed, weak oral sucker, and a short blind cecum. Cilia are absent and the larva swims and creeps by means of the caudal lamina to a *Necturus* where it attaches to the gills. Organs of attachment develop rapidly, digestive cecum bifurcates, and reproductive organs appear. The life cycle is complete in approximately two months. The development of this species and descriptions of life cycles of other Monogenea show that at some time in their development all have free swimming larval stages similar to *Dactylogyrus.* It is postulated that *Dactylogyrus* is near the primitive ancestral type of the Monogenea.

58. A Diphyllobothrium from Cats in the Syracuse Region. JUSTUS F. MUELLER, New York State College of Forestry.

This worm has been taken on several occasions from cats in Syracuse and in the region of Oneida Lake, and cannot be identified with any previously described species. The length and general dimensions roughly correspond to those of *D. mansoni,* but the uterus makes only two terminal loops as compared to the three or four of *D. mansoni.* The vagina, nerve trunks, and bothria also show differences from this latter species. The eggs are pointed, and hatch in 50 days. In the character of the uterus and shape of the egg this worm belongs to the subgenus *Spirometra.* Although the transmission has not been worked out, the evi-

dence in hand indicates that fish carry the plerocercoids. If true, this is at variance with *D. mansoni,* which has the plerocercoid in frogs and snakes. An apparently identical worm has been found in the dog. A detailed study of the form is now in process of publication.

59. Polyandry and Polygamy in Parasitic Worms. ALLEN MCINTOSH, Bureau of Animal Industry, Washington, D. C.

Polyandry in the Nematoda, as found in the classic example *Trichosomoides crassicauda,* has been known for some time. Here as many as 6 males have been reported from the uterus of one female worm. The males are very small and retain certain larval characters. Polygamy has been recently observed in the trematoda (in *Macrobilharzia macrobilharzia* Travassos, 1923, a parasite occurring in the hepatic portal system of *Anhinga anhinga.* The male of this fluke is from 40 to 57 mm. long by 3.5 mm. wide; the female is only about one tenth as large. Sexual dimorphism is so great that the female (*Paraschistosomatium anhingae* Price, 1929) when first discovered was regarded as a separate species and made the type of a new genus. The writer examined several birds in Florida and found both males and females, thereby revealing the true relationship of what had been described as two generically different species. Mature females occurred in large numbers in the small mesenteric blood vessels leading to the viscera. The males are far too large for these minute blood vessels and are found in the large hepatic portal vein instead. Seldom were females found in this large vein, but in one instance a male was found here with 5 females in the gynaecophoric canal. Two of these females were virgins; three had their seminal receptacles filled with spermatozoa, their uteri containing 4, 12 and many eggs, respectively. The males, usually 1 to 3 per bird, are far scarcer than the females.

60. A Protozoological Survey of 700 College Freshmen. D. H. WENRICH, R. M. STABLER and J. H. ARNETT, University of Pennsylvania.

A previous report gave the results of fecal examinations of 401 freshmen entering college in 1932. In the following year, 299 additional freshmen were examined making a total of 700, of whom 220 were women and 480 were men. The average age of these students was 19.4 years and 76.6 per cent came from homes in Penna., 19 per cent from homes in N. J., and 4.4 per cent from other states. Examinations of fresh material alone yielded 259 protozoal infestations as against 288 from stained slides alone, a difference of 11.2 per cent in favor of the latter method. Both methods together yielded infestations to the number of 305, which is 5.9 per cent greater than that for stained slides alone. Among the 305 infestations, 184 or 77 per cent were single, 44 or 18.4 per cent were double and 11 or 4.6 per cent were triple. Incidences for the 700 cases are given and, for comparison, the percentages for the first group of 401 cases are recorded in parentheses: *Blastocystis,* 63.1 per cent (61.0 per cent); some protozoa, 34.0 per cent (33.1 per cent); *Endamoeba coli,* 13.9 per cent (13.2 per cent); *Endolimax nana,* 11.3 per cent (12.0 per cent); *Giardia lamblia,* 7.9 per cent (8.7 per cent); *Endamoeba histolytica,* (including the smaller races), 4.1 per cent (4.5 per cent); *Dientamoeba fragilis,* 4.4 per cent (3.5 per cent); *Iodamoeba bütschlii,* 1.3 per cent (1.2 per cent); and *Chilomastix mesnili,* 0.71 per cent (0.66 per cent). Again no cases of *Trichomonas* or worm infestations were detected, but proper culture and concentration methods were not employed. The percentages for the total of 700 cases are not greatly different from those for the first group of 401 cases. In the total count, the incidence for *Dientamoeba fragilis* is slightly higher than for *Endamoeba histolytica.*

61. The Comparative Toxicity of Certain Anthelmintics. H. W. BROWN and P. D. LAMSON, Vanderbilt University.

The comparative toxicities to white rats of thymol, ascaridole, carbon tetrachloride, tetrachlorethylene, hexylresorcinol, certain alkyl cresols, and alkyl

phenols given orally as well as a summary of the deaths following the use of some of these substances in man is presented.

62. The Blood Picture in Children in Louisiana (U. S. A.) Infested with Trichuris trichiura. G. F. Otto, Johns Hopkins University.

Hemoglobin determinations and erythrocyte counts were made on 140 school children in Louisiana harboring *Trichuris trichiura* and other intestinal helminths, usually *Ascaris lumbricoides*; 197 children harboring only *T. trichiura,* and 213 children negative for all helminths. Differential white cell counts were also made on the latter two groups. The average blood picture was essentially the same in all three of the above groups. When the groups were broken up into different age groups some variation was found but it could not be correlated with age or helminthic infestation. The hemoglobin average for the different groups ranged from 10.95 to 11.69 gm. per cc; erythrocytes 4,380,000 to 4,920,000 per cm; polymorphonuclear neutrophiles 43 to 50 per cent; eosinophile 3 to 7 per cent; basophiles 0.3 to 0.9 per cent; lymphocytes 41 to 52 per cent; mononuclear 1 to 2 per cent; transitional cells 2 to 3 per cent. The hemoglobin content and erythrocyte count is lower than the normal figure for adult blood and the former is lower than the generally accepted level of hemoglobin in children. The appearance of the children would also indicate a low grade anemia which I am inclined to believe is related to undernourishment, for the diet of most of the children is inadequate both in quality and quantity. The differential counts vary somewhat from the normal for children but are difficult to interpret. There is, however, no correlation between either these differential counts or the low hemoglobin content of the blood and the presence of *T. trichiura.*

63. Blood Studies of Experimental Infections with the Dog Hookworm, A. caninum. A. O. Foster, Johns Hopkins University.

Hematological readings on dogs infected both orally and cutaneously with the dog hookworm have given strong support to the view that the anemia of hookworm disease is mainly, if not entirely, the result of blood-loss. The eosinophila, on the other hand, appeared to be associated with the death of larvae in the tissues. The blood of infected animals showed diminished R. B. C. and hemoglobin along with microcytosis and hypochromia. There was also, in most cases, some leucocytosis and eosinophilia; the latter being more marked in resistant animals and in cases of skin infection. It was possible to parallel the development of the anemia in the infected animal by periodic bleeding of uninfected animals, while it was likewise possible to produce an eosinophilia in the normal animal by the intradermal injection of dead larvae. In a few cases the effect of iron therapy was determined and it was found that the anemia of hookworm disease responded about as well in reticulocyte count and in other respects as did the anemia produced by artificial hemorrhage. This result is interpreted as indicating a healthy condition of the hemopoietic centers, a condition which opposes the postulation of a toxin affecting the formation of blood elements.

64. Artificial Immunization of Rats Against Trichiniasis. O. R. McCoy, The University of Rochester.

Previous work has shown that after recovery from even very light infections with *Trichinella spiralis* rats possess a potent immunity against reinfection. Attempts have been made to establish this immunity in various ways without actually infecting the animals. Rats were given 6 intraperitoneal injections at 5 day intervals with 5,000 living trichina larvae digested free from muscle. (Larvae in the peritoneal cavity usually are removed by phagocytosis in from 24 to 48 hours without undergoing any development.) Three weeks after the last injection a light test inoculation (about 10 larvae per gram of body weight) was given by stomach tube to the injected rats and to an equal number of control animals. In four experiments the injected rats uniformly showed some degree of immunity

as measured by the numbers of larvae which developed in the muscles. The degree of immunity shown by the individual animals varied from practically none at all in a few rats to almost complete immunity in the majority. Resistance developed in this manner could be broken down much more readily by a large dose of larvae than could that conferred by the actual infection of the animals. The intraperitoneal injection of heat-killed larvae and of dried and pulverized larvae also has resulted in the production of a partial immunity, the degree of which is apparently somewhat less than that following the intraperitoneal injection of living larvae.

65. Protozoa from the Intestine of Chimpanzees. ROBERT HEGNER, Johns Hopkins University.

The protozoa of the chimpanzee have been studied very little considering the close relationship of this host to man. Fifteen animals in Baltimore and 22 in Orange Park, Florida, were examined for intestinal protozoa. Ten fecal samples from each were studied by the smear and culture methods. Eleven species were found. The incidence ranged from 66 per cent with *Balantidium* to 11 per cent with *Iodamoeba.* Every animal was infected with from 1 to 8 species (average 3.2) and no antagonism was evident between the different species of protozoa. Flagellates were noted in culture in many cases before they were found in smears. Four examinations revealed over 80 per cent of the infections. No injurious effects were noted in the hosts except a tendency to diarrhea when large numbers of *Balantidium* were present. Some evidence of infection by association was obtained from animals kept together in one cage, but in some cases different protozoa were present in cage mates; differential susceptibility and resistance were thus revealed. *Giardia* occurred most frequently in the youngest specimens as in human beings. Four species were recorded, apparently for the first time, from chimpanzees, *Giardia, Retortamonas, Hexamita* and *Trichomonas* from the vagina. Drugs appeared to have been effective in removing many infections at Orange Park, but *Balantidium* and *Giardia* seemed particularly resistant to treatment.

66. Amoebastatic Properties of Dyes upon Endamoeba histolytica *in vitro.* H. TSUCHIYA, Washington University.

Amoebastatic properties of various dilutions of basic and acidic dyes were determined upon *E. histolytica in vitro.* It was found that there existed a distinct "amoebastatic zone" which was variable with the kinds and strengths of dyes used. Amoebastasis was best shown by the use of gentian violet, acriflavine and malachito green and to a lesser extent by acid fuchsin. Its apparent absence was noted with safranin and neutral red, while the remaining dyes exerted a more or less intermediate degree of amoebastasis. Amoebastasis was, as a rule, manifested by a partial penetrability of dye into the cysts, and was characterized by the prolongation of the lag period before detectable evidence of growth of the organisms *in vitro.* It was noticeably increased by an exposure of the cysts to an incubator temperature than those of room and refrigerator. Furthermore, by the use of certain dyes, the extent of amoebastasis was found to be directly proportional to that of bactericidal power upon the accompanying bacteria *in vitro.* Thus, there was an apparent increase in size of the organism, as bacterial population became decreased. Instances of "dye resistant" strains were also observed during the course of this experiment.

67. Further Studies on the Cultivation of Endamoeba histolytica. H. TSUCHIYA, Washington University.

A coagulated slant of Dorsett's medium, when superimposed on by the liquid medium (5 cc. of nutrient broth with two 4 mm. loopfuls of sterile starch-charcoal mixture) serves as an excellent medium for *Endamoeba histolytica.* Cysts should be washed by repeated centrifugalizations after filtration and sedimenta-

tion of feces, and a small amount introduced to the medium. Preliminary warming of the medium to body temperature, as formerly indicated, is not necessary. A suspected material may be sent from reasonable distance for diagnosis, provided the medium is overlaid with solid paraffin. When washed cysts are exposed to the action of gentian violet-acriflavine mixture (1 : 100 dilutiion each) at 37° C. for one hour, and then inoculated into the medium, the amoebae usually maintain growth for several days without further transfer. Trophozoite-containing feces or material obtained by means of a proctoscope is first emulsified with a sufficient quantity of normal saline, and left standing for half an hour at 37° C. About 0.1 cc. of the sediment is then inoculated into the medium.

68. The Utilization of the Starch-Charcoal Mixture in the Cultivation of Balantidium from Guinea-pigs. H. Tsuchiya, Washington University.

By an addition of the starch-charcoal mixture (as in the case of the cultivation of *Endamoeba histolytica*) to a modification of Rees' medium (1 cc. of sterile inactivated human mixed sera and 9 cc. of sterile Ringer's solution), *Balantidium* may successfully be cultivated. The value of rice starch has been stressed by Rees and Schumaker. The addition of animal charcoal further accentuates the growth of the organisms, as the charcoal adsorbs ammonia and hydrogen sulphide and induces a partial anaerobiasis by the adsorption of oxygen. Under conditions of strict anaerobiasis, however, the growth is extremely poor. This supports the contention of Schumaker. Primary cultures may be kept for days, provided a loopful of the starch-charcoal mixture is added whenever needed. The optimum incubation period at 37° C. is 72–120 hours. Division is observed as early as 36 hours' incubation, and more frequently, as incubation continues. Subcultures may be made by introducing to a fresh medium a portion of the sediment from the primary culture. Attempts to obtain pure line culture by single cell isolation has failed thus far. By means of the dilution cover slip method of Cleveland and Saunders, however, the introduction of 25 or more balantidia gives rise to a good growth.

69. The Cultivation of the Balantidium of the Chimpanzee in Fecal Extract. Floyd Atchley, Johns Hopkins University.

I cultivating *Balantidium,* previous workers have found Ringer's solution and horse or pig blood serum (10 per cent) plus rice starch to be a practical method. An extract of chimpanzee feces in Ringer's solution with rice starch added has been demonstrated to be more favorable for the growth of the *Balantidium* from the intestine of the chimpanzee. Sterilization by filtering did not improve the medium. These protozoa have lived and multiplied at intervals for as long as 55 days in fecal extract when rice starch was given daily. There is no reason to believe that they could not be carried along for more extended periods by continuing transfers every second or third day. Dried fecal extract, kept in the ice-box approximately six months and then strired into Ringer's solution was not as satisfactory as the fresh extract. Conclusions are based upon daily counts treated statistically of the number of living balantidia in the test-tube.

70. Notes on Two Coccidia Reported from Man. John F. Kessel, University of Southern California.

1. *Isospora hominis—Isospora bigemina.*

Sporocysts containing four sporozoites have been recovered recently from a patient in the Los Angeles General Hospital who presented no gastro-intestinal symptoms. Only sporocysts were recovered though the patient was purged in an attempt to recover oocysts. A duodenal drainage was also performed but no parasites were collected. The sporocysts ranged from 14 μ to 16.5 μ in length and from 9 μ to 11 μ in breadth, the average being 15.4 μ x 9.5 μ. They showed no organized residual body though scattered particles of residual material were commonly arranged along the lateral margin of the sporocyst.

The feces of a pet cat belonging to the patient were examined and found to contain sporocysts of an *Isospora,* approximately the same size as the ones recovered from the patient. The sporozoites, however, were somewhat shorter than the sporozoites recovered from the human case and the residual body was more definitely organized. No oocysts were recovered from the cat.

These sporocysts answer to the previous descriptions given for *Isospora hominis* of man and *Isospora bigemina* of the cat. Two questions are raised (1) Are the two species identical? and (2) Does man acquire his infection from cats?

2. *Eimeria butkai.*

Eimeria butkai was reported originally by Causey (1926) as a new species of coccidium from man. Recently the writer was shown the original material by Dr. H. E. Butka who collected the stool from one of his patients. The stool contained numerous objects similar in size and appearance to the descriptions of Causey. The writer feels, however, that these are yeast-like in form and he was unable to find any organisms that presented characteristics of a coccidium. It would therefore appear to him that the name *Eimeria butkai* should not be accepted as an authentic species until corroboratory data are collected.

71. The Effect of Atabrine and Plasmochin on the Haemoproteus *Infection of the Pigeon.* G. Robert Coatney, Peru State Teachers College.

Experiments involving some 35 birds were carried out to ascertain the effect of Atabrine and Plasmochin on *Haemoproteus columbae* of the pigeon's blood. Treatment was entirely oral. The Atabrine was given in 40 mg. doses and the Plasmochin in doses of 10 mgs. to birds, showing only adult gametocytes, to those with one to two day-old forms, and to young birds before parasites had appeared The Atabrine removed the adult gametocytes from the blood in from 14 to 30 days and the young forms in from 6 to 12 days. The female gametocytes seemed more resistant to the action of the drug than the males, the latter showed morphological (degenerative) changes on the third day and the females not until the sixth day of treatment. Plasmochin brought about the removal of both old and young parasites in from 3 to 4 days. Male and female gametocytes responded equally well to treatment. Neither drug seemed to have any effect on the asexual cycle in the lung since parasites appeared in the circulating blood when treatment was begun before there was any evidence of infection and relapsed during treatment. Increasing the dosage to the limit of the bird's tolerance did not add to the efficiency of the drugs.

72. Helminth Egg Counts Plotted on a Logarithmic Scale. J. Allen Scott, International Health Division, Rockefeller Foundation, and Department of Public Health, Cairo, Egypt.

Hookworm egg counts as commonly plotted tend to form a "J" shaped distribution with statistics inherently difficulty of interpretation. Earle and Doering have recently suggested that when the logarithm of the number of eggs is plotted instead of the number itself, the distribution approaches the shape of a normal curve with convenient statistics and attendant ease of interpolation from the straight line formed on probability paper. Studies of Egyptian population groups seem to show that egg counts of other helminths will yield to the same method of conversion. Not only do the egg counts of intestinal parasites such as hookworm (*A. duodenale*) and *Ascaris lumbricoides* appear to follow this rule, but also counts of the number of eggs of the blood inhabiting *Schistosoma haematobium* appearing in the urine and of *S. mansoni* appearing in the feces. Simplification of tabulation methods to be published in detail later have obviated certain technical difficulties encountered in attempting to apply the suggestions of the above mentioned authors. By these means also a diversity of series may be plotted to the same scale, and from a single tabulation the counts may be displayed corrected to basis formed as commonly practised, as well as without this correction as recommended by the authors cited.

73. The Epidemiology of Hookworm Disease in Palestine. J. Allen Scott, International Health Division, Rockefeller Foundation, and Department of Health, Palestine.

In certain villages in the coastal plain near Jaffa, Palestine, from 50 to 80 per cent of the population have been found to harbor hookworm. Other villages in the same locality have relatively few infestations, while the intensity of infestation as shown by egg counts is roughly proportional to the percentage incidence. In the heavily infested villages about 15 per cent of the population were in high egg count groups showing a measureable reduction in average hemoglobin. The variation in the amount and severity of hookworm infestation seems to be correlated with the number and age of orange groves in the villages rather than with any physical or climatic factor. Indictment of orange culture as the most important epidemiological factor is supported by the fact that fields where other crops are grown are not generally irrigated, and are usually too dry for the development of hookworm larvae. Furthermore laborers in the orange groves come from the most heavily infested population groups. A study of soil infestation showed infective larvae to be present during the relatively rainy winter season in certain areas within the villages where effective contact is made by the people. On the other hand many more important areas were found in summer in the orange groves where the shade, heat and irrigation produce very favorable conditions for larval development. If as seems probable the orange groves furnish the more important sources of infestation, hookworm disease may very likely be increasing along with the current increase in citrus cultivation.

74. Anomalous and Non-Specific Reactions with Trichinella spiralis *Antigen in Relation to Other Disease Conditions.* George W. Bachman, R. Rodríguez-Molina and J. Oliver-González, School and Tropical Medicine, San Juan, Puerto Rico.

The fact that human trichiniasis has not been found in the Island of Puerto Rico enabled the authors to study the specificity of the precipitation test for trichiniasis in relation to other diseases conditions existing in Puerto Rico. Anomalous and non-specific precipitation reactions were studied in sera from 857 trichinella-free individuals living on the Island. From the 857 sera tested, 35 (4.8%) gave an anomalous type of reaction. This reaction or haze which appeared at the interphase of the antigen and serum, was rarely found in low dilutions (1 : 100–1 : 500) but seemed to increase in width and intensity in higher dilutions and frequently appeared in the Coca's serum control. Seventy-two (8.4%) gave non-specific precipitation reactions, and 750 (87.5%) gave negative reactions. The titers of the sera that gave non-specific reactions varied from 1 : 100 to 1 : 3000 in terms of dry weight of trichina powder. In the precipitation tests of these 72 sera, 18.0% gave a titer of 1 : 100; 19.4% of 1 : 200; 41.6% of 1 : 500; 11.9% of 1 : 1000; 4.0% of 1 : 1500; 2.08% of 1 : 2000; 2.08% of 1 : 3000. The authors deduce from these investigations that the precipitation test for the diagnosis of human trichiniasis does possess a fairly high specificity in relation to other disease conditions, such as diseases produced by parasites, bacteria and fungi, as well as in conditions where there is nitrogen retention and increased cholesterol and chlorides in the blood. In cases of malaria, the ingestion of variable amounts of quinine previous and during the time of the tests, did not affect the specificity of the reaction. It is the experience of the authors that the presence of the anomalous reactions can be easily differentiated from the true, positive precipitation rings.

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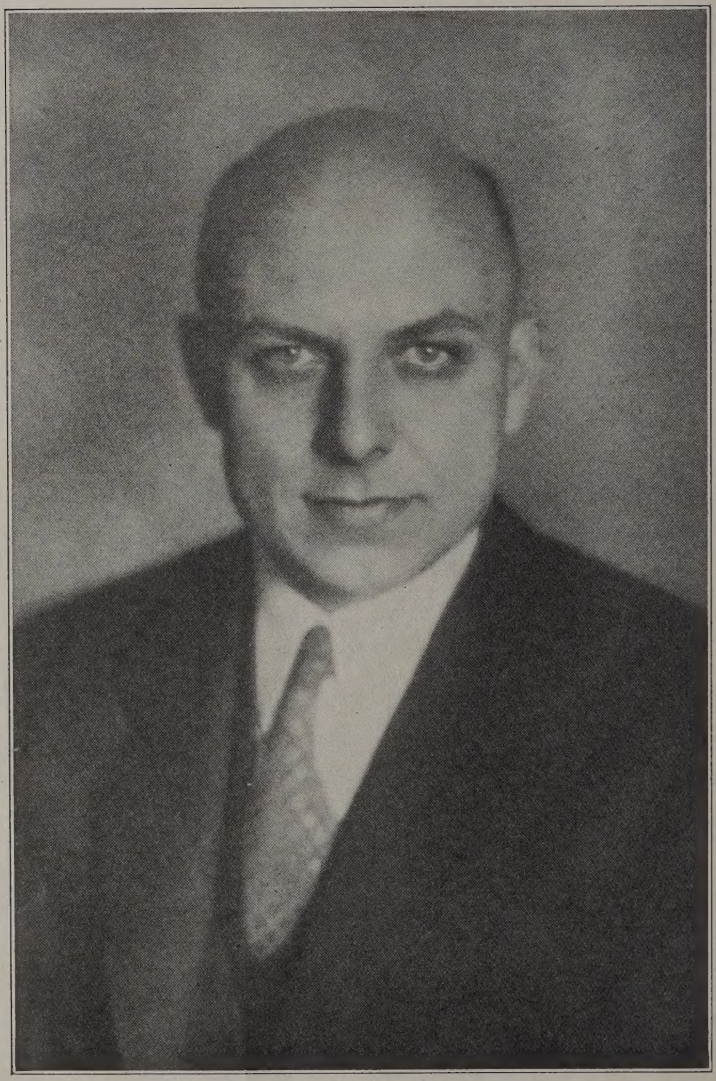

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